Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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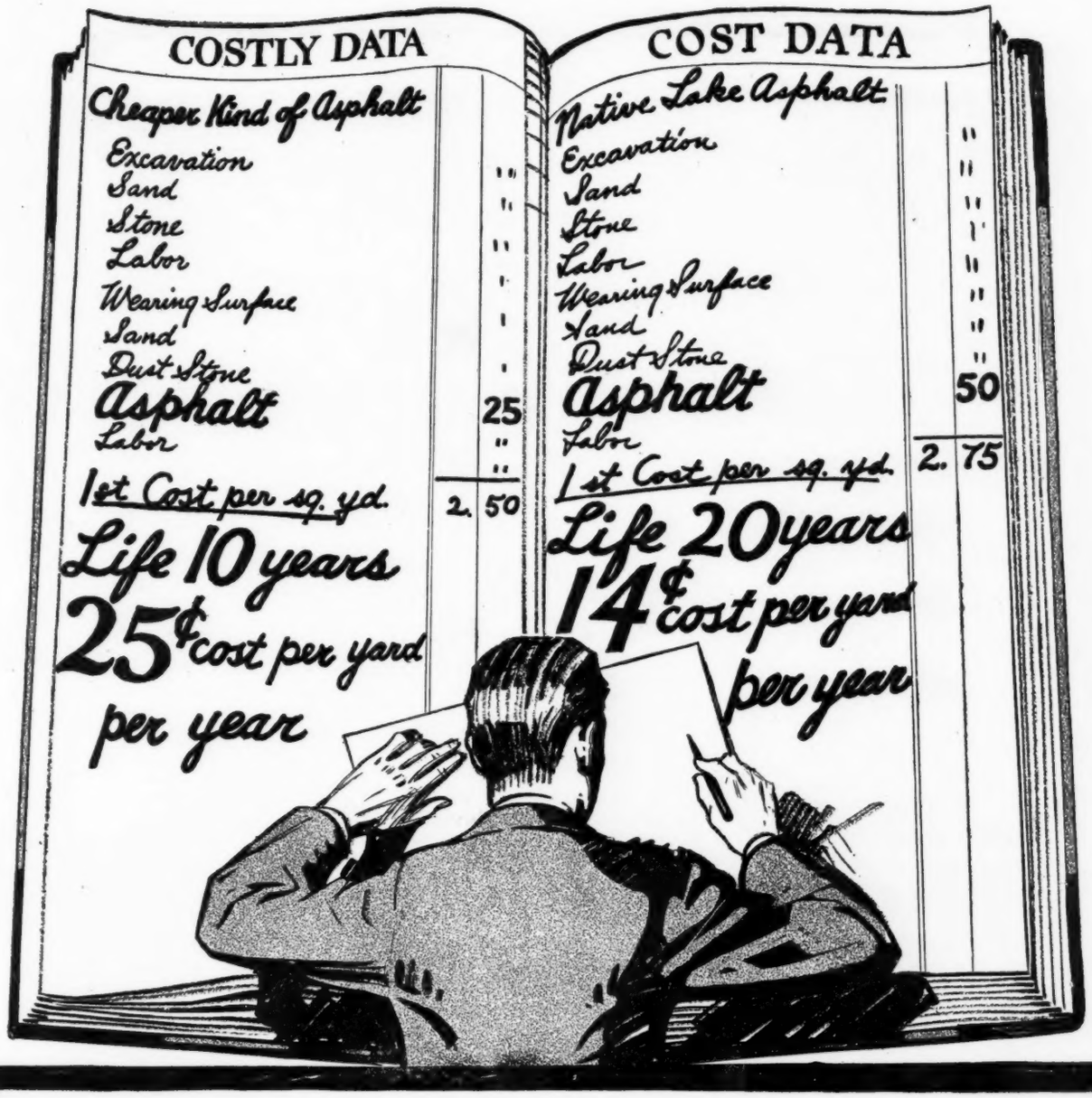

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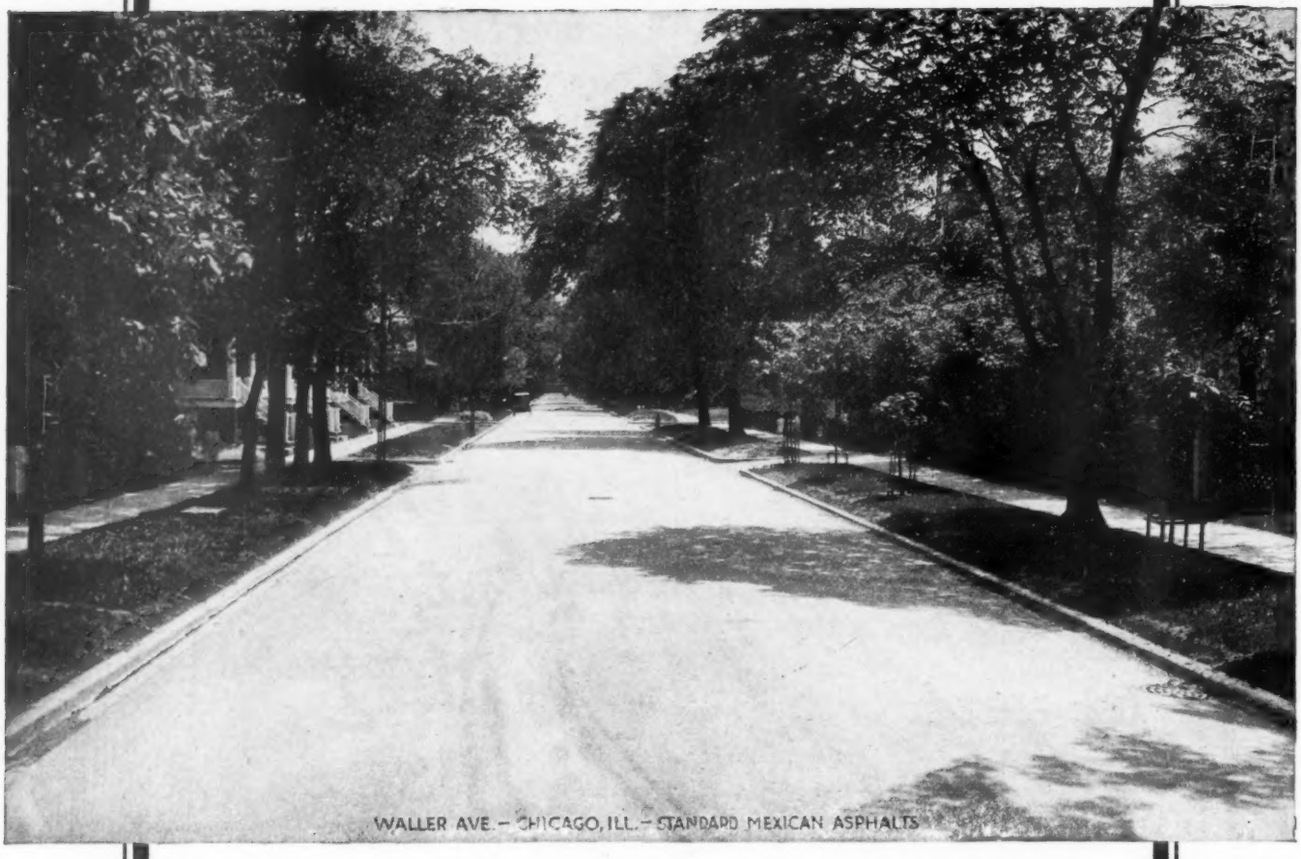

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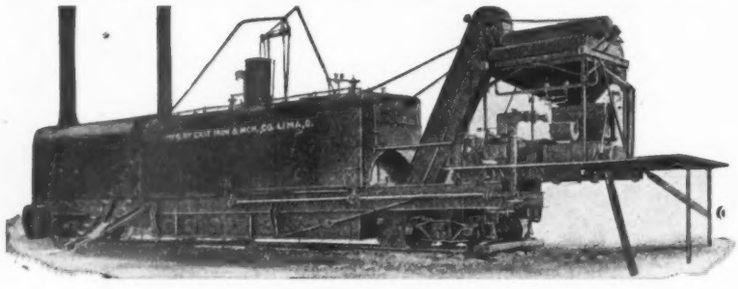

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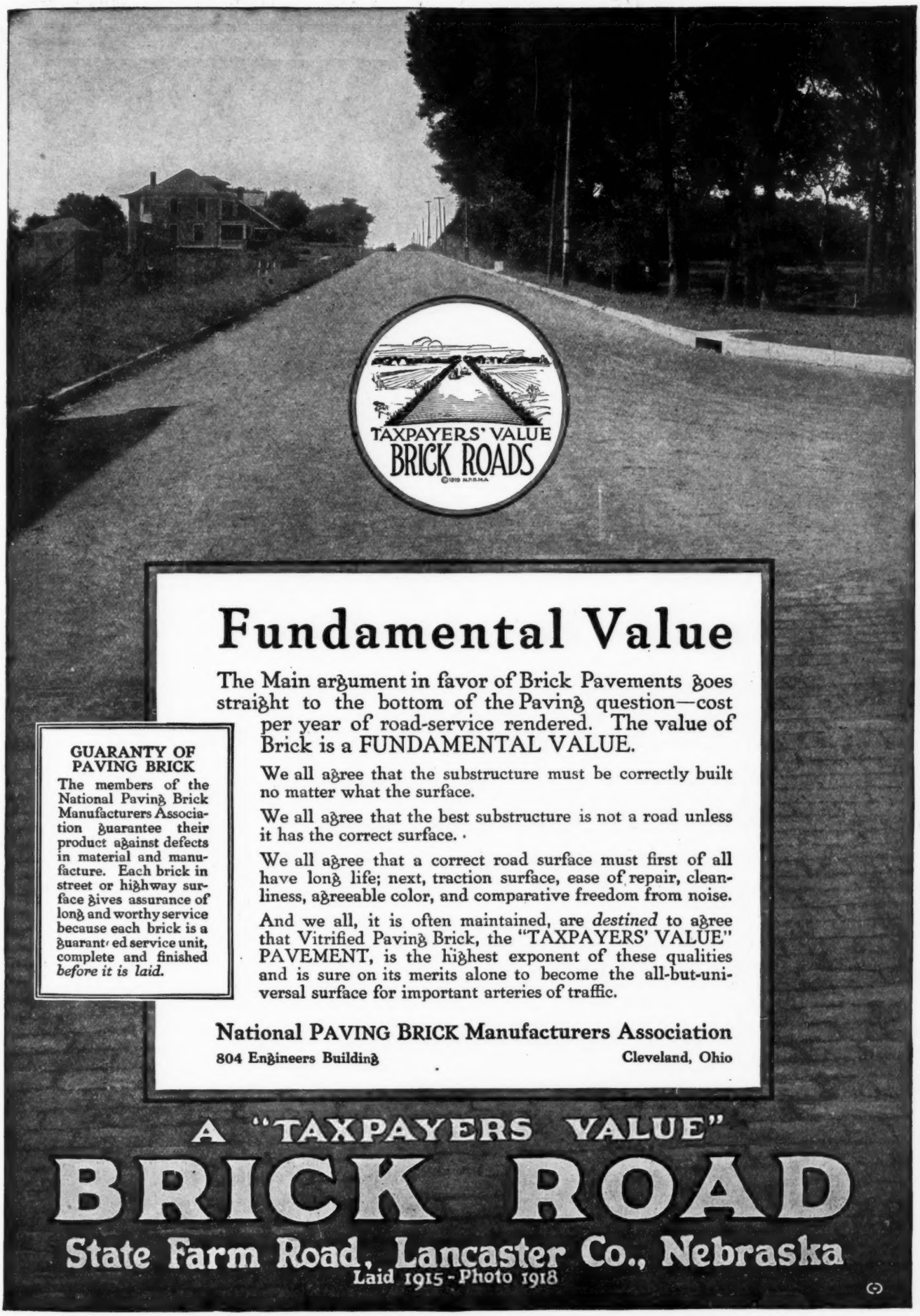

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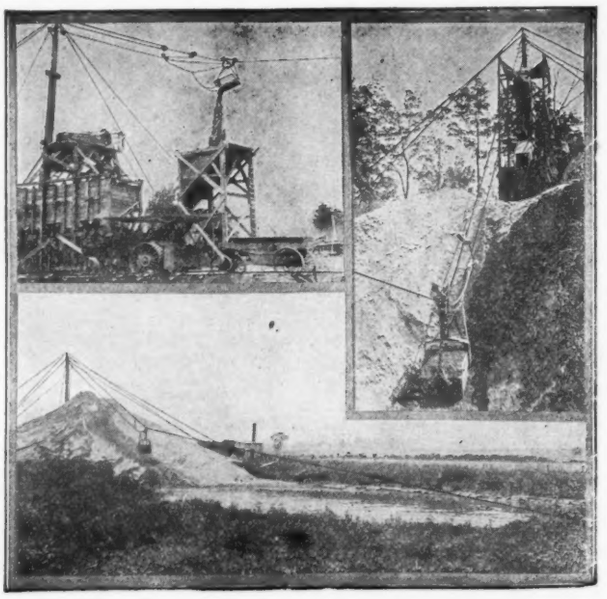

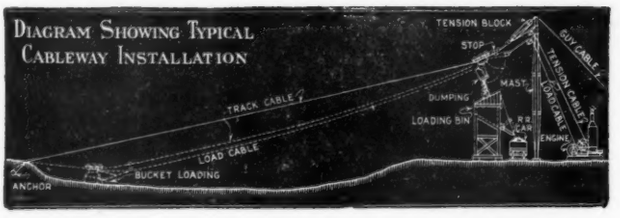

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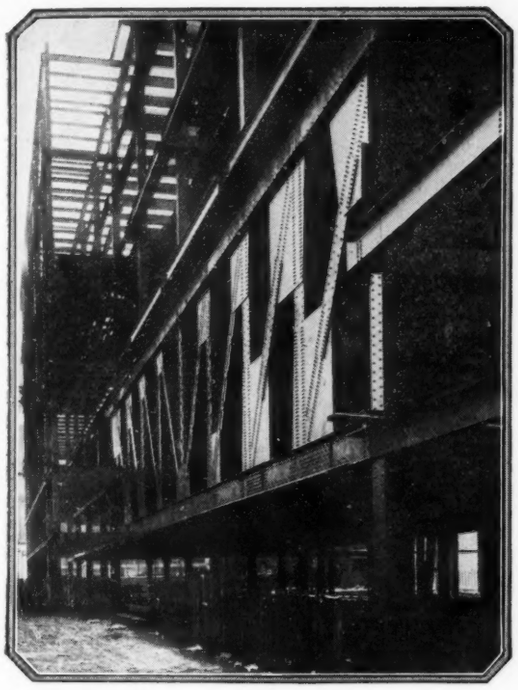

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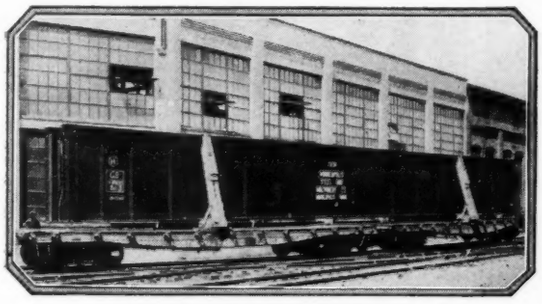

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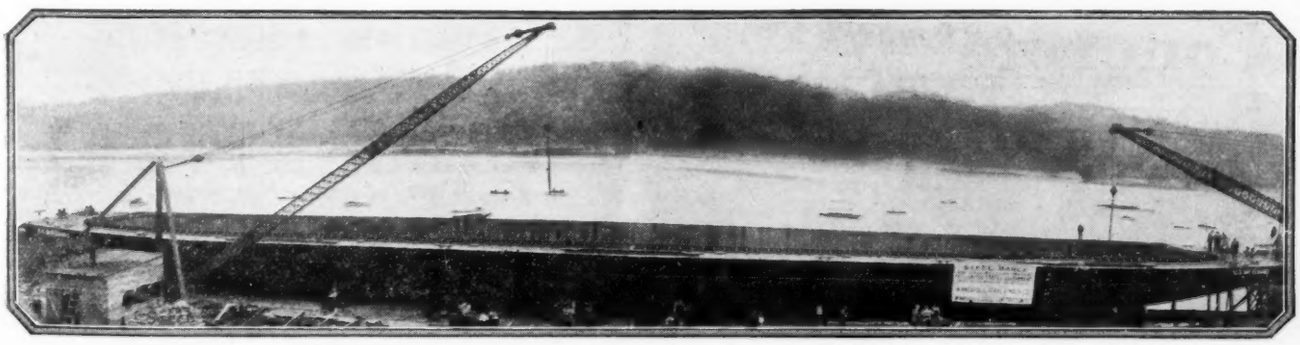

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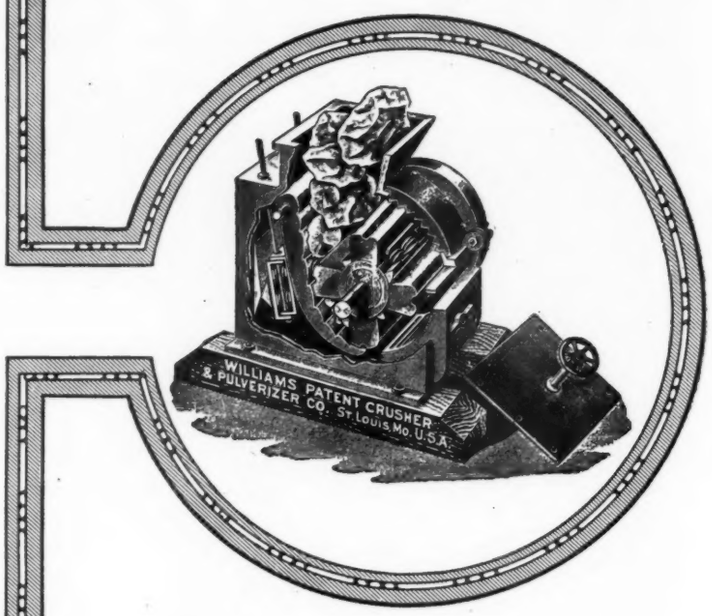

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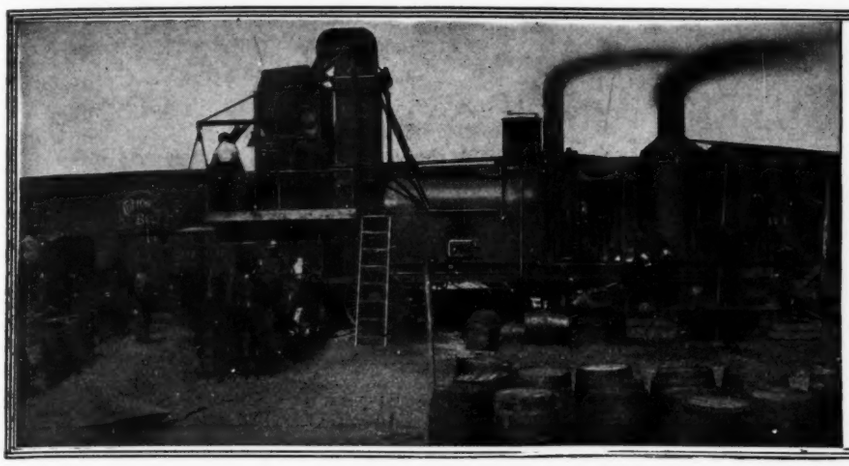

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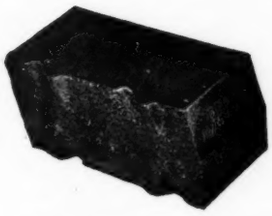

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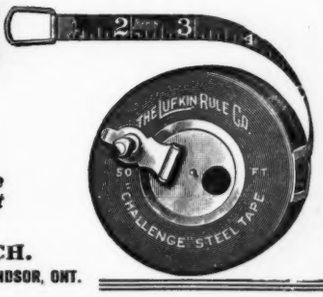

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The Autocar Company
Ardmore, Pa.

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Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, December, 1919.

Motor Truck Operation and Accounting LII

The editor's correspondence with engineers in State Highway organizations continues to furnish interesting examples of the economy of motor haulage on road construction work. Quotations from a few such letters follow:

Mr. Austin F. Shure, Resident Engineer, Maryland State Road Commission, writes:

While the following facts and figures may not apply to every locality I find in my residency that the truck is the most satisfactory and economical for hauls of more than 2 miles. The northern part of my residency is very hilly and rough and the southern portion is flat and very sandy, therefore it becomes necessary to use both the horse drawn vehicle and truck for doing our work. For instance, on a very sandy road leading from the State Road to a railroad siding or wharf the truck is of very little use to us but elsewhere whenever it is possible to get a truck for the purpose it is used in preference to the horse drawn vehicle.

During 1918 I had 1,500 tons of gravel hauled with truck, the average haul was about 3 miles. This work cost us 25cts. per ton-mile to haul. The truck was loaded from hoppers, however, and there was no delay at the loading point and all of the hauling was done over an improved road where the grades were very light.

In another section of my residency I hauled about the same amount of gravel with teams. The average haul in this case was about 3 miles and this work cost me about 35 cts. per ton-mile. In this case about ½ a mile of the haul was very heavy sand where the truck could not have been used and all of the loading was done by hand. If we should have equipped ourselves in such a way that this hauling could have been done by truck I believe that possibly the truck hauling would have cost more than the team hauling as we would have been required to place a temporary surfacing on the sandy road and do more or less incidental work to provide for quick loading and etc.

During 1919, all of our chip hauling for oiling work was done by truck. possibly 6,000 tons was hauled in this residency in this way and this was done by contract at 32 cts. per ton-mile which included the cost of unloading and all demurrage. In this instance I would say that the average haul was approximately 4 miles and all of the hauling was done over improved roads. It would have been impossible to have moved such a quantity of material in horse drawn vehicles in about a month's time as teams could not have been gotten and in addition to this it would have been impossible to unload and haul by a horse drawn vehicle at such a figure. In this locality the horse drawn vehicle has been done away with, with the exception of places where the truck cannot be used as I have already noted. It is not only more economical but it expidites the handling of the material.

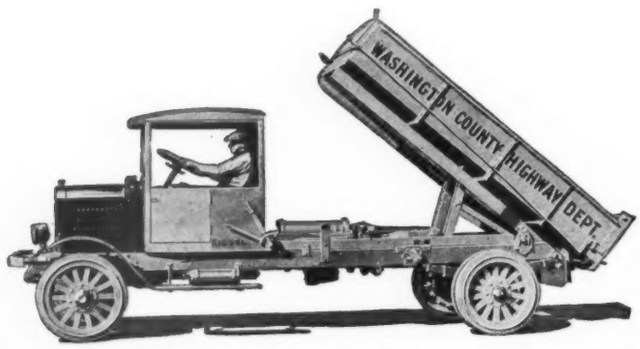
A. W. Bushele, Division Engineer of the Connecticut Highway Commission at Norwich, Conn. writes:

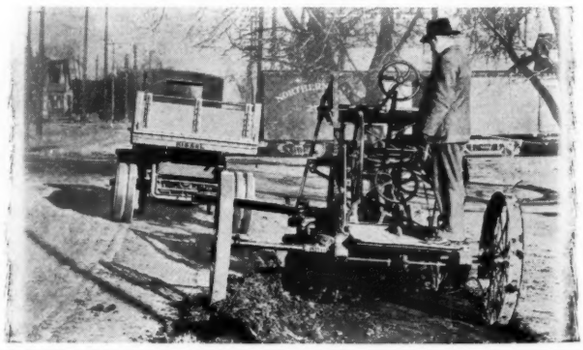
We have found in this district that with teams at $8.00 a day, and 3-ton trucks at $25.00 a day, that on hauls of a round trip of a mile or more trucks were the more economical. Under a mile round trip, teams seem to be more economical. We have not used tractors or trailers in this district as our hauls, as a rule, did not warrant their use.

H. E. Snyder, Division Engineer, West Virginia State Road Commission, Union Trust Bldg., Parkersburg, W. Va., writes:

The highway work in this State is conducted by the County Courts; that is, the fiscal authorities for the 55 counties in this state. Most of the work is done by contract, and accordingly, it is not practicable to obtain haulage costs. In the few instances where the counties are equipped to do their own work the preference is given to trucks where they are available.

Wood county in this State will engage in the construction of 8 miles of concrete surface road improvement next year, and the work will be in charge of a newly organized road department. Wood county has four trucks and will, in all probability, secure four more before the beginning of construction next spring. In addition to these, teams and dump wagons will be employed.





ROAD BUILDERS FIND AN ECONOMICAL SOLUTION OF THEIR PROBLEMS IN THESE KISSEL TRUCKS. THE KISSEL STANDARD OF MANUFACTURE INSURES RESISTANCE AGAINST WEAR.

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ARE ADVERTISED BY THEIR OWNERS

NOTICE TO TAXPAYERS

"The undersigned makes this statement for the benefit of the taxpayers of Warren county. There has been a great objection and kick on the use of the truck on maintaining and keeping up our county roads. I have driven a Wilson truck one hundred and three days in the county and worked in every township in the county but one, and in that time I hauled 1,030 yards of gravel an average distance of 5½ miles. I pulled a road drag 198 miles and the road grader 128 miles. I have kept an account as correctly as possible, and in my judgment, it will cost $7 per day to operate a truck, not counting anything for repairs, and in the 103 days we spent 50 cents for a fan belt, $2 for two spark plugs, total $2.50. As this objection is found all over the county, some found fault with the commissioners and some found fault with the road superintendent and some did not know who to blame. A great many ask if I thought it paid. Well, boys, a truck properly handled and put the push in it will do the work of from 5 to 9 teams, and to bear this statement out, will refer the doubters to the men I worked for, Lewis Noles, of Pine Village, Harvey McElhoe, of Williamsport, Chas. Renville, of Pence, Chas. Hickman, of Tab, Norma Bartlett, of Rainsville. The sub-superintendents of the county think that my statement will enable the taxpayers to figure out for himself as to whether the truck pays. The county needs one truck in each commission district is my judgment in the matter of trucks."

(Name on request.)

This clipping appeared in a local newspaper recently and affords food for thought. We consider it one of the most striking endorsements for ***Wilson Motor Trucks*** ever written. Name of paper and road commission on request.

J. C. WILSON COMPANY

DETROIT, U. S. A.

The work will be in charge of a competent engineer who will keep a record which will show the actual cost per mile for haulage of each kind. The average one-way haul for the work mentioned above, which will be on the three roads, is 6 miles.

Truck Scores in Solving Contractor's Problem

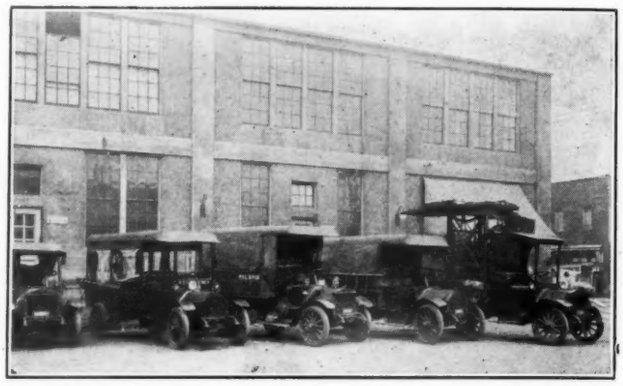
Backing a truck down a 15 percent grade to dump a heavy load of earth at the bottom in a hollow 30 ft. deep, is no easy job. Yet a 3½-ton truck is doing this 34 times a day for the Dempster Construction Co., of Knoxville, Tennessee.

The one truck in their service has enabled the Dempster people to do work that they could not have attempted with wagon equipment, and has meant an actual saving of $60 a day over the work that was once done by teams.

When the company took a contract with the University of Tennessee to level a new athletic field, it had a two-fold problem, namely, to remove over 50,000 cu. yds. of earth from the field and to fill a deep hollow with this earth. There were two ways of reaching this hollow, one a short cut down a 15 percent grade that ran back about 600 ft., and the other a long roundabout route over very bad road to the other side of the hollow where the slope was more gradual. Originally they used 14 wagons of about 1¾ tons capacity drawn by three mules each, and two light trucks. With this equipment, of course, they had to take the roundabout route. The road was so bad that a 2-ton internal gear driven truck struck one spot which strained the entire chassis and internal gear mechanism to such an extent that the jackshaft pinion was thrown entirely out of line and merely idled with the rear wheel so that the truck could not move.

Then too, they found that this equipment could not keep up with the steam shovel because it took so long to unload and return and since their capacity was so limited. They solved the problem by installing a 3½-ton Mack dump truck which could take the short cut and make 34 trips a day. By using the teams and small trucks on the round about route and the Mack on the short cut, they were able to keep the steam shovel in constant operation, saving a great deal of time and money.

To dump the earth by way of the short cut necessitated backing the truck down the entire grade and dumping its load at the edge of the bank. It had to back through soft dirt at the very bottom and to the edge of the excavation with absolute sureness and pull up the hill again. Large and dependable brakes were required to prevent the possibility of the truck going over the bank in the act of dumping the heavy load.



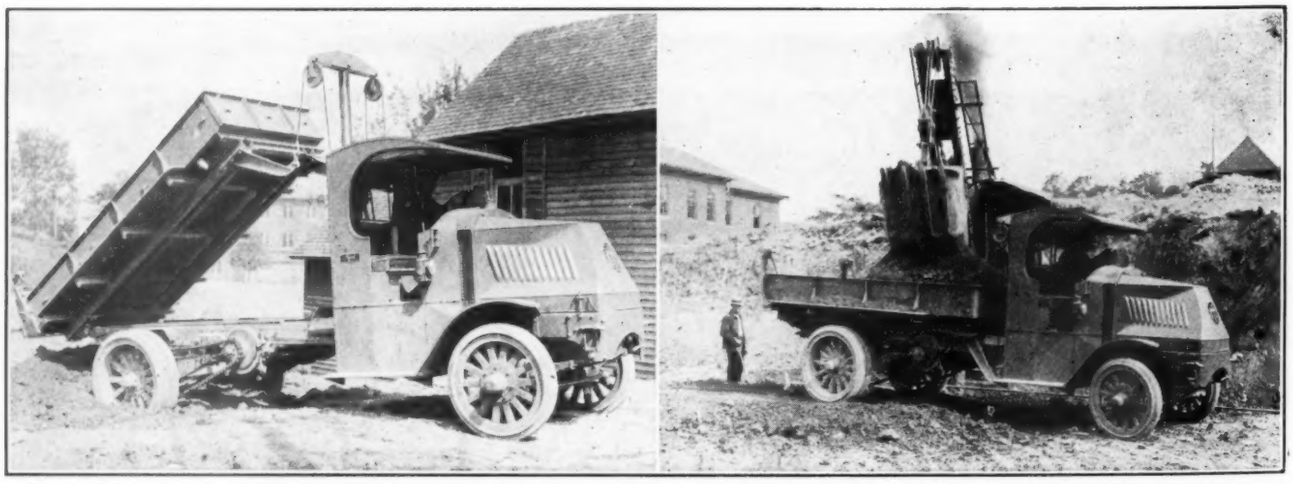
FLEET OF FIVE FEDERAL TRUCKS OPERATED BY THE PORTLAND RAILWAY LIGHT & POWER CO., PORTLAND, OREGON.

Says George R. Dempster, president of the company, "Such performance exceeds our expectations of the adaptability of the motor truck to our business, and of the economy in big units. We would never think of going back to team-drawn vehicles. All further additions to our transportation equipment will be heavy duty trucks such as this."

Light and Power Co. Operates Five Federals

Keeping the activities of the public service corporations in shape to render service to the public is one of the many important jobs given to the motor truck. Telephone and telegraph lines, gas companies, electric power and street car companies have learned to rely on the flexible motor trucks to care for all needed repairs.

The Portland Railway Light and Power Company, Portland, Ore., was one of the first public service companies on the Coast to turn to the motor trucks. In fact, in 1910 they purchased the first Federal truck to go to the Coast which was the sixth manufactured by this company. For four consecutive years after, another Fed-



MACK 3½TON DUMP TRUCK AS OPERATED ON EARTH MOVING JOB BY THE DEMPSTER CONSTRUCTION CO., OF KNOXVILLE, TENN.

SERVICE Builds Bakersfield Streets

Playing an important part in the construction and upkeep of the streets of Bakersfield, California, is SERVICE Motor Truck Equipment.

In municipal work, where all kinds of conditions must be met and overcome, SERVICE Motor Trucks have proved themselves, by dependable, constructive and economical performance, fully equal to the most severe demands.

SERVICE Motor Trucks equipped with dump and other specialized bodies, are in use by Chicago, Indianapolis, Columbus, Atlanta, Kansas City and many other cities.

There is a SERVICE Motor Truck built to meet every Municipal Requirement

SERVICE MOTOR TRUCK CO. Wabash, Ind. U. S. A.

Distributors in all Principal Cities and Foreign Countries.

NEW YORK, 87-89 WEST END AVE CHICAGO, 2617-25 S. WABASH AVE

Service MOTOR TRUCKS

Builders of Business

eral was purchased, and today all five are still on the job of keeping Portland lines and tracks in order. In the accompanying picture the second truck from the right, is the first one purchased, the second from the left following in 1911.

Pierce-Arrow Trucks on Big Contracting Job

Working without halt, three 5-ton Pierce-Arrow trucks operated by the United Construction Co., of Hammond, Ind., since May, 1918, have earned substantial profit in contracting work.

"Absolute freedom from mechanical troubles has enabled the trucks to work so consistently that the contracting firm is always ahead of schedule on jobs" says Robert O. Patten, truck sales manager.

In road construction work in Hammond during the summer and fall of 1919, the trucks hung up a remarkable record. Their delivery of materials was so regular that the firm was able to work its force at full efficiency, its workers never being idle through lack of materials.

From July 22d to October 10th, two of the trucks, working 9 hours a day, hauled 510 carloads of stone, or 20,400 yds. The haul was about a mile. No time was lost in loading, this being accomplished with a steam-operated bucket. In unloading, the trucks, which are equipped with 4-yd. dump bodies and hydraulic hoists, spread the crushed stone through lifting the hoist and moving ahead simultaneously.

"They did not stop one minute," said an official of the company. "The only attention given them was to replenish gasoline, oil and grease."

The third unit was used in hauling cement. Round trips of 19 miles have to be made, but the truck regularly made five of them a day, an average daily mileage of about 95 miles a day. The truck hauled 185 barrels of cement daily.

In the fall of 1919 two of the trucks were approaching the 11,000-mile mark. The third has not traveled so far. The repair bill for this mileage, however, is insignificant.

48 of First 50 Pierce-Arrow Trucks Still in Service

"Forty-eight of the first fifty Pierce-Arrow motor trucks are in operation today, after eight years' usage."

This fact, the basic message of a new booklet published by the Pierce-Arrow Motor Car Company, stands as unique in the motor world, says Robert O. Patten, truck sales manager of the company.

"It is proof conclusive of the permanency of Pierce-Arrow trucks, and is a claim that can be advanced by no other truck manufacturer," says Mr. Patten. "Such permanency makes the first cost unimportant, for it spreads the initial outlay over many years of profitable service.

"Even if other makers could produce one truck—not 48—which has survived so many years of operation, it would not prove the worth of their present models, for it would present a design far different. Not so with the Pierce-Arrow. Its basic design and construction has not been revolutionized as have other makes; it has only been improved."

The booklet, which is entitled, "The First Fifty," gives the history of each of the veteran trucks, which were built in 1911. Only one was retired and this served through seven years of drastic use. The other not running was destroyed in a fire three years ago.

"The First Fifty" is a valuable addition to motor truck literature, says Mr. Patten, for it traces the experience of users in many different lines of business in which Pierce-Arrow motor trucks have served reliably for 150,000, 250,000, and even 300,000 miles.

Truck on a 55-Mile Haul

In a certain community, 55 miles from the nearest railroad transfer point on the main line of one of the big railroad systems, the uncertainty of receiving their merchandise and supplies became so acute that the merchants called a meeting with the following results as reported by Harry Branstetter, Chicago Kissell distributor:

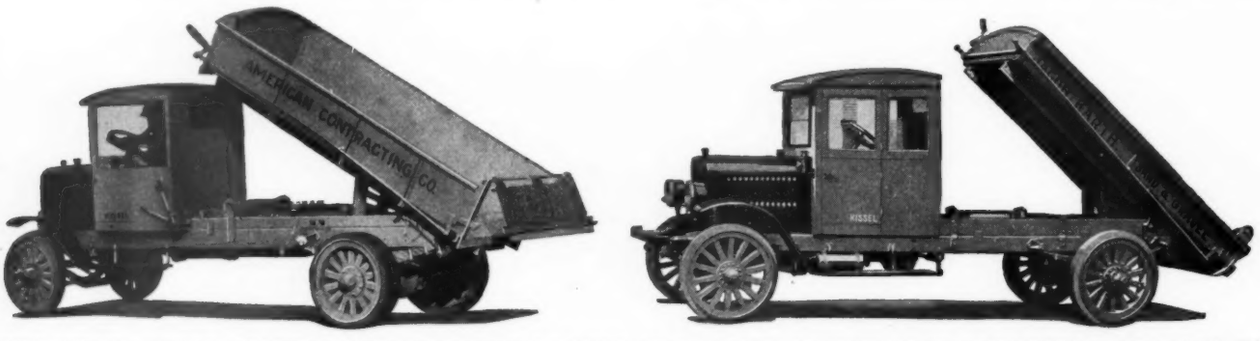
By having their goods shipped to the transfer point only, they could get a better rate and a better shipping schedule. Then instead of waiting for the goods to be shunted 55 miles up the side line to their town, they bought three motor trucks, and by operating them on a joint basis, they found they could get their merchandise into their stores much earlier and oftentimes at a lower cost.

As it was time, and not expense they wanted to cut down, their trucks soon paid for themselves, especially as they were loaned out to farmers when not employed in the regular transport work.

Using Trucks to Help Out the Railroads

Director General Hines of the United States Railroad Administration in a statement made public recently predicts a serious shortage of freight car transportation facilities. The statement is addressed to shippers and receivers and urges them to help relieve the impending congestion.

Commenting on the announcement, R. E. Fulton, Vice-President of the International Motor Company, said:



THE KISSEL TRUCK CHASSIS TAKES THE TYPE OF BODY NECESSARY FOR THE MOST ECONOMICAL SOLUTION OF CONTRACTORS' HAULAGE PROBLEMS.

KISSEL TRUCKS

The Cost of a Good Truck

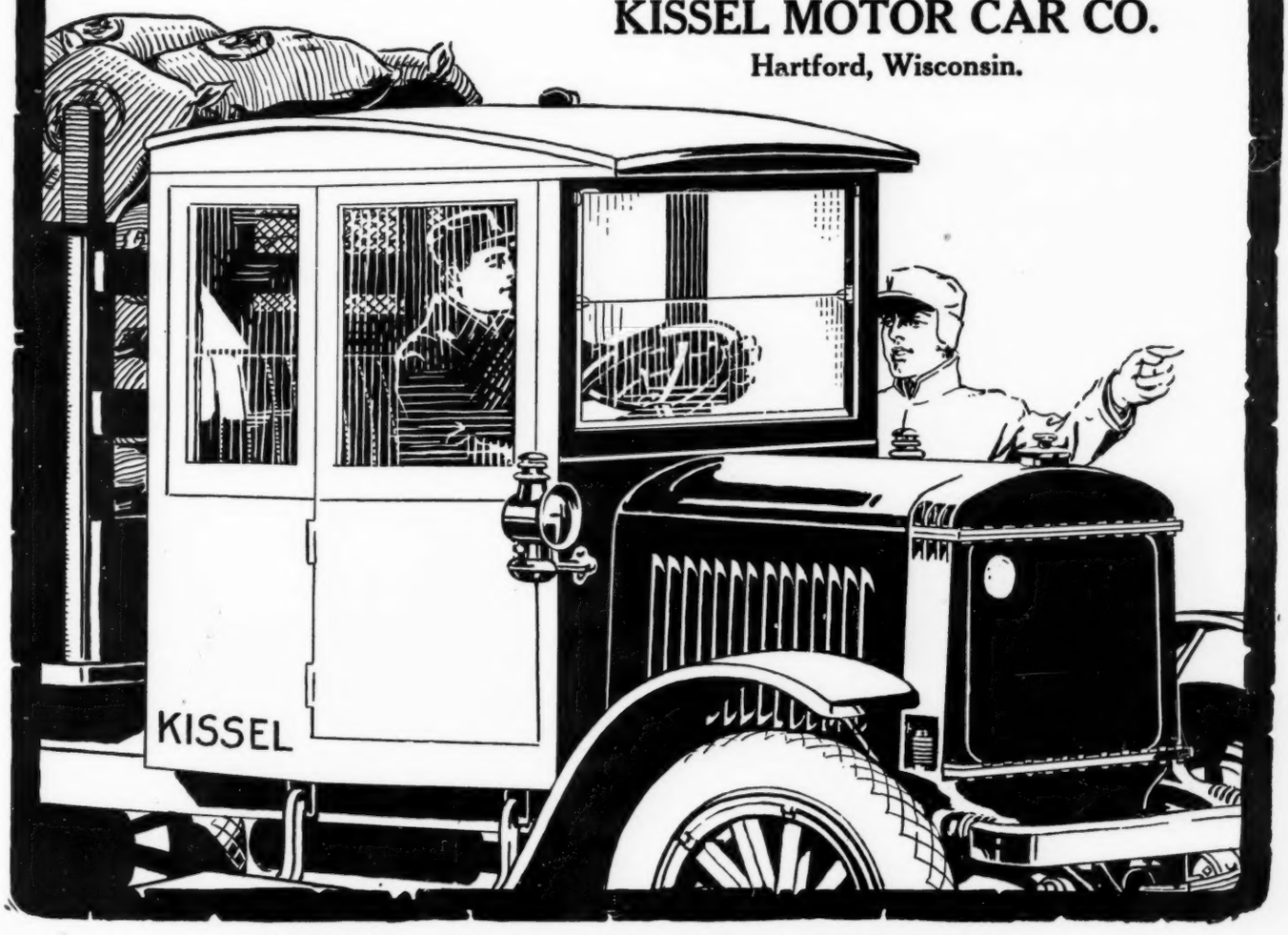
IT is not the initial cost or the purchase price—but the cost per ton mile in transporting goods that counts. In other words—the operating, repair service and depreciation expense of the truck determine its **real** value.

Kissel Trucks are above everything else QUALITY TRUCKS. The highest grade material, units and mechanical features only are employed—which make them **cheapest** in the end. ***Kissel Trucks are built up to a quality—not down to a price.***

"There's a difference, as our nearest truck distributor will prove. See him.

Don't miss the complete Kissel Truck display at the New York National Truck Show, January 3 to 10.

KISSEL MOTOR CAR CO.
Hartford, Wisconsin.



"Director Hines' appeal prompts the question, 'In what way can the motor truck best serve to assist the Railroad Administration?' To answer this is but to emphasize the necessity of co-operation with the railways rather than competition. Let the motor truck take over completely the traffic it has already proved itself to be the more efficient in handling. Let them be, in effect, branch lines and feeders of the railroads to unload the freight at the outlying railroad yards and deliver it to the consignee's door, incidentally at a lower cost and more quickly. This would release valuable car space that is ordinarily tied up in switching cars around within a city, and eliminate the necessity of leaving cars on siding or spur tracks until they can be picked up by a locomotive.

"The development of motor express routes to handle tonnage over shorter distances should be encouraged because they relieve freight cars for longer distance transportation. Shippers as well as the motor express companies should do all in their power to provide capacity loads and eliminate every bit of waste space they possibly can.

"This appeal by the Railroad Administration has a vast significance to the motor truck industry. It is proof that the railroads do need the co-operation of all the participants in the nation's transportation scheme, and that the motor truck will be called upon more and more each day to take over the traffic that the railroads cannot accomodate. To the dealer it offers unlimited encouragement and should be an incentive to intensify selling efforts. To the general public it will mean better transportation service at a lower cost. The goods shipped by motor truck will reach the consignee quicker and in better condition. As far as cost is concerned, the motor truck has already shown that it is more economical than the railways in this form of transportation. Yet a great many people have still to be educated to these advantages, and it requires the force of circumstances such as this to provide that education. When there is anything that has always been done in a certain way, the general opinion is that it cannot be done any other way until the pinch of necessity gives another method an opportunity to demonstrate its value."

Necessity of Changing Oil in Motors

A campaign to call attention to the necessity of changing oil in motors every so many hundred miles has been advocated by M. L. Pulcher, vice-president and general manager of the Federal Motor Truck Company, Detroit, Mich. He contends that failure to change oil frequently is the main cause of the deterioration of motors.

Mr. Pulcher points out that there is so much kerosene in gasoline today that it has a tendency to run down past the pistons, get into the lubricating oil and thin it. The kerosene cuts the thin film of oil on the wearing surfaces of the pistons, piston rings and cylinder walls.

With the film of oil on the wearing parts of the motor broken, friction, the bugbear of motor efficiency starts in. The pistons work up and down through broken films of oil in a lubricating substance that has lost considerable of its richness and thickness.

There is little chance of changing the quality of the gasoline. Therefore, to prolong the life of the motor the only thing to do is to change the lubricating oil frequently, possibly every 500 to 1,000 miles, he advocates.

An experiment witnessed by Mr. Pulcher recently is instanced by him as proof that it is the non-lubricating qualities of the oil that damages motors.

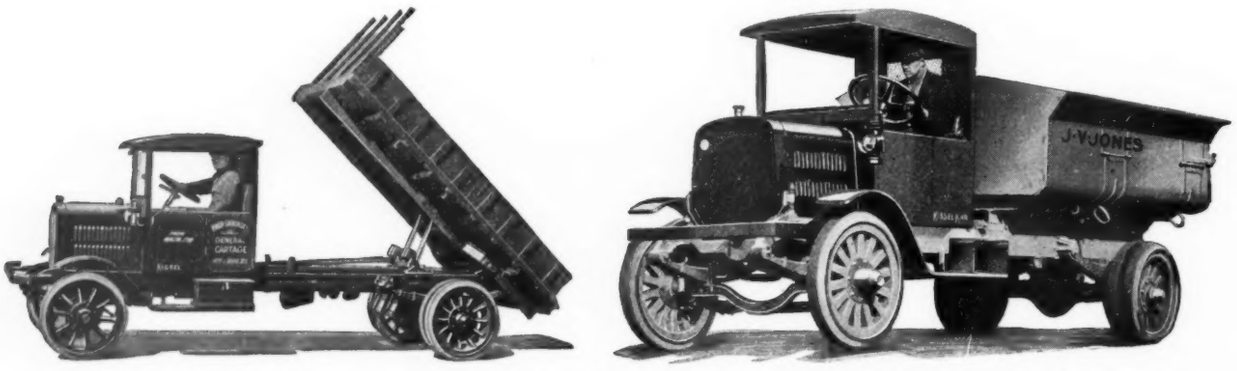
A motor was brought into a shop with almost 0.015 in. wear. The motor was ground to 0.020 in. oversize, fitted with new pistons, put on the block and filled with good, clean oil. The motor was then run continuously for 60 hours and during this time the oil was changed three times. When the motor was taken down it showed no wear.

The motor was again put together, oil was taken from an old truck and the motor put through the same 60 hour test without any change of oil. It showed 0.005 in. wear, indicating that it is the non-lubricating qualities of the oil resulting from the kerosene working in past the pistons and mixing with it that causes the deterioration of motors.

Influence of Motor Traffic on City Planning

Those municipal improvements for quick and convenient traffic communication between all parts of the city are a necessity, and those civic organizations that are back of the schemes to anticipate congestion in the business centers, and remove it before it reaches that point where stagnation and confusion result, should be fully co-operated with not only by the business interests but the entire population of that community." says George A. Kissel, President of the Kissel Motor Car Co.

"No transportation equipment, no matter how versatile or adaptable, can exert its greatest capacity and become an efficient transportation carrier, unless provisions are made whereby its scope of operation is not curtailed by street limitations.



KISSEL EXTRA—STRENGTH, FLEXIBILITY AND STAMINA GIVE LONG WEAR WITH CONTINUOUS SERVICE.

Get This Truck's Record Is All We Ask

We honestly believe that no business house, in its own interest, can afford to buy any truck withous fully informing itself about the Gramm-Bernstein.

It should know, for example, that there exists a distinct preference for this truck among experienced buyers.

It should know, also, that this preference—which, by the way, is enjoying a very healthy growth—is a perfectly logical development.

It should know that Gramm-Bernstein owners are genuinely satisfied.

Our owners will testify that a Gramm-Bernstein lasts literally for years.

That operating upkeep and repair costs are extraordinarily low—and especially so in ratio to the service the truck renders.

And that when they need another truck, or more trucks, their choice is invariably the Gramm-Bernstein.

These things are important to a prospective truck-buyer.

They are important to us, for they tend to confirm our belief that the Gramm-Bernstein represents the soundest truck engineering practice in America.

This belief is based on something more than a truck-building experience now rapidly approaching 20 years.

It is based on Gramm-Bernstein records and performance.

It is strengthened by the fact that Gramm-Bernstein features were adopted bodily for the Army's trucks, and that they had long before proved themselves practical and successful.

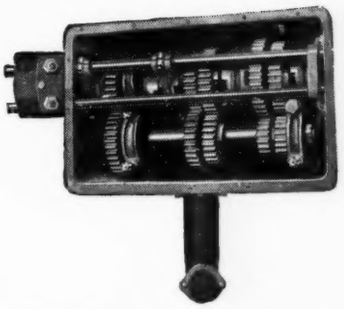
Gramm-Bernstein engineering finds its latest expression in our new 5-ton truck, which has already had a test equalling two years' ordinary travel of a 5-ton vehicle.

We ask no business to buy our trucks on our say-so—though that is a perfectly safe thing to do.

Gramm-Bernstein performance and service are matters of record. Any one of our dealers will place the facts before you, and put you in touch with our owners.

The most we ask is that you get the complete information.

Gramm-Bernstein Worm-Drive Trucks, in 1½, 2, 2½, 3½ and 5-ton capacities, are now sold completely equipped, ready for the body—not an extra to buy.



The Gramm-Bernstein transmission is completely trouble-proof. It is actually a basic superiority. Careless driving, hard work, cannot possibly harm it.

The gears are always in mesh. They are never shifted, never ground, never clashed. Speed changes are made through patented dog clutches.

Gears and clutches are progressively assembled on a heavy six-spline shaft and can never get out of alignment. Not a pin, bolt, nut, set-screw, stud or key, which might work loose, fall out, and possibly damage the entire gear set, is used in the gear assembly.

All Gramm-Bernstein Transmissions are provided with a pad for attaching Gramm's Basic Patent Power Take-off. Dealers and truck owners should assure themselves that any trucks purchased with power take-off do not infringe B. A. Gramm's Basic Patent No. 1194994.

The Gramm-Bernstein Motor Truck Co., Lima, Ohio, U.S.A.

Pioneers Since 1901—Builders of the First Liberty (U. S. A.) Truck

Keeping trucks out of the shop

THE efficiency of a truck depends on the aggregate work it does. So we leave nothing undone to keep your Pierce-Arrow trucks working.

We build them as carefully as fine machines must be built if they are to last—of right design and the best materials. We test them thoroughly *before* we sell them.

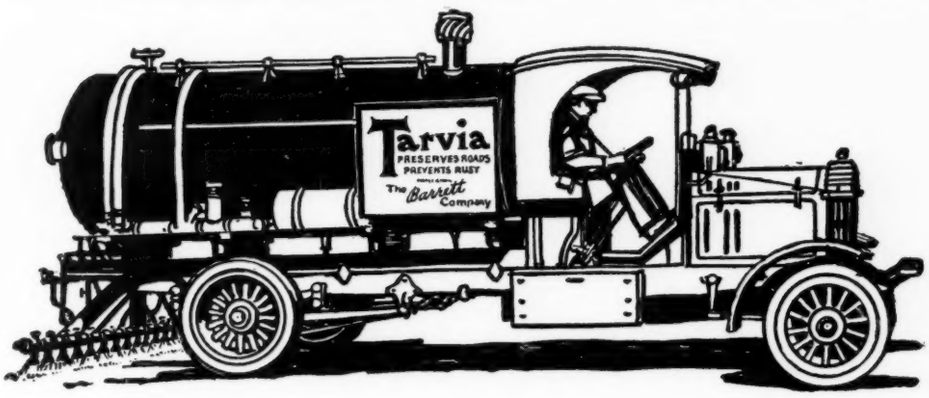
Our interest doesn't stop there. We teach your men to handle them and we inspect them monthly to prevent abuse or neglect. All of our experience is at your disposal.

This care keeps Pierce-Arrows out of the shop and on the job—rolling up mileage, piling up earnings.

That is why Pierce-Arrows are the cheapest trucks to buy, why none has worn out in 8 years.

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

THE BARRETT COMPANY operates a fleet of thirty-four Pierce-Arrows throughout the east. Their tank trucks used for spreading Tarvia road dressing, operate on a radius of forty miles around supply cars, and have demonstrated remarkable dependability.



Delivers more work in a given time;
Loses less time on the job and off the job;
Costs less to operate and less to maintain;
Lasts longer, depreciates less and commands a higher resale price at all times.

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.

Pierce Arrow

"This includes those narrow streets that have outgrown their former usefulness as side streets and have blossomed forth as part of the main arteries of the community, and should be widened immediately.

"Uniformity of thoroughfare work is very necessary. I have in mind a certain section of a city in the middle west, which by widening certain streets, the width of which in 19 dfferent places varied from 30 to 100 ft., to a given uniform width of 84 ft., would afford a direct avenue of travel to the city proper, thereby facilitating traffic and creating a transportation efficiency of which it is badly in need.

"It is common also in a good many cities to find a street come to an abrupt end for a block, after which the street is continued. No doubt the founders never dreamed that more and wider streets would be necessary and thought that in laying them out they were anticipating all possible road expansion for hundreds of years to come. Where such streets, by continuing them through the block, would create an outlet for additional traffic, thereby eliminating congestion and confusion, the property owners as well as city and government officials should take immediate steps to rectify it.

"The automobile and motor truck have been found practically 100 per cent. efficient for city, inter-city and interstate traffic, and inasmuch as the manufacturers have perfected their product to such a high degree, it is up to the business interests as well as the civic interests of every community to see that these carriers are given every possible chance to make good by providing continuous thoroughfares of sufficient width to accomodate not only motor traffic but all traffic in both directions. By doing this, economical transportation will keep pace with the natural expansion of their community without creating expensive congestion and confusion."

Good Roads as Factors in Reducing Transportation Costs

"The day is not far distant when motor trucks will operate over highways built solely with that purpose in view. When that day comes motor truck transportation will have reached its height," says E. A. Williams, Jr., President of the Garford Motor Truck Co.

"The Department of Agriculture estimates that for the year 1918 motor truck hauls from farm to shipping points averaged 11.3 miles while wagon hauls averaged 9 miles. The motor trucks made 3.4 round trips per day over the 11.3 miles while wagons made but 1.2 trips per day over the nine mile route.

"The average cost per ton by the horse-drawn vehicles was 30 cts. per mile for wheat, 33 cts. for corn and 48 cts. for cotton. The truck haulage per ton mile averaged 15 cts. for wheat and corn and 18 cts. for cotton. In several states the cost of transporting wheat was as low as 9 cts. per ton mile while the lowest cost by wagon is estimated at 22 cts. per ton mile. Quite a saving there, without taking into consideration the value of time saved and the economy in labor.

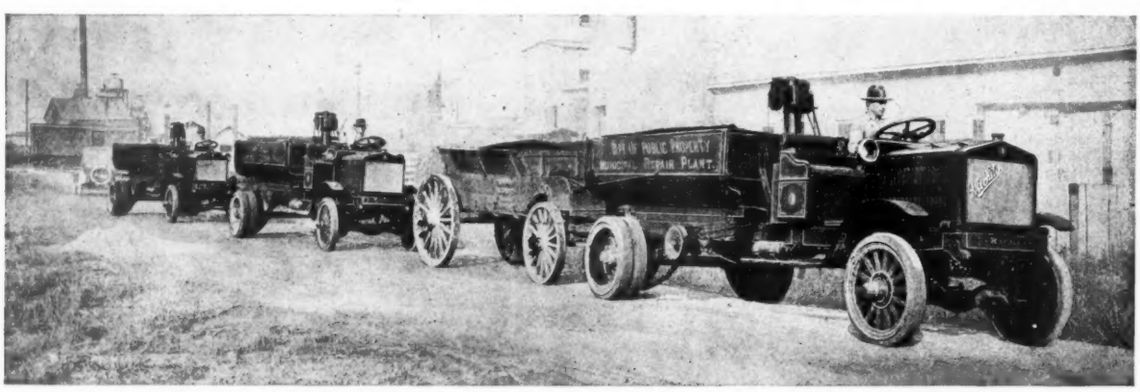
"The figures compiled by the government show definitely the importance good roads play in the reduction of costs. For instance, in the East North Central States, which boast miles of improved highway, the cost of haulage by truck was but 9 cts. per mile in 1918. In the New England States, the Middle Atlantic States and the West North Central States the cost was 14 cts. The cost increased to 18 cts. in the South Atlantic States where there are a limited number of improved roads and to 29 cts. in the Rocky Mountain district where, of course, the grades affected all means of transportation.

"Contrasted with these figures are these showing the costs of hauling by horse-drawn vehicles. In the East South Central section, the cost is 36 cts. per ton mile, more than three times the cost by truck. In the South Alantic States it is 39 cts., more than twice as much as by motor. In the Rocky Mountain district the cost reaches 42 cts., 13 cts. more than the truck costs.

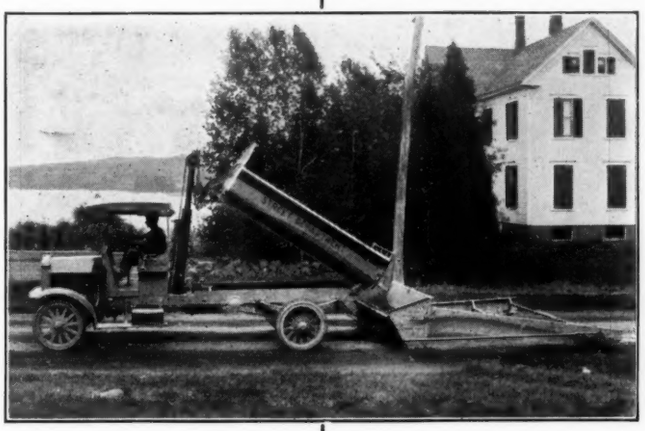
"After considering those figures one stops to wonder what the present cost of food-stuffs would be if it were not for the motor truck. New York has more than 55,000 motor trucks registered. The average cost of hauling by truck in New York is 14 cts. per ton mile according to last year's figures. The cost by wagon is estimated at about 30 cts. There is a difference of 16 cts. on each ton per mile. In a year the saving would run into an enormous amount."

RECONSTRUCTION OF NARROW ROADWAYS FOR MOTOR TRUCK TRAFFIC

(Editor's Note: Following is the report as amended submitted by the Committee on Reconstruction of Narrow Roadways of Trunk Highways with Adequate Foundations and Widths for Motor Truck Traffic, submitted at the meeting of the American Road Builders' Association on Nov. 7, 1919. It is only a progress report, as it would be unwise to draw definite conclusions from factors which are still indefinite in the building of roads and pavements. The members of the committee are: H.



WICHITA 5-TON DUMP TRUCKS AS OPERATED BY THE CITY OF NEW ORLEANS, LA.



Federal hydraulic hoist dump truck pulling a Burch sand spreader. Owned by City of Laconia, N. H.

Another FEDERAL

This Federal Equivalent to a Gang of Laborers

For road grading and sanding, the City of Laconia, N. H., has certainly hit upon a happy combination for speed, efficiency and economy.

Using a Federal dump truck with hydraulic hoist, and attaching a Burch sand spreader to the rear of the truck's frame, a road working unit is obtained which dumps, spreads and grades at one operation.

Need we comment further on the dollars-and-cents economy of such an investment in these days of high-priced labor, Mr. City Engineer?

Prices and complete information on a similar outfit for *your* city will be gladly given on request.

"Return Loads Will Cut Your Haulage Costs"

FEDERAL MOTOR TRUCK COMPANY
35 FEDERAL STREET DETROIT, MICHIGAN

FEDERAL

One to Five Ton Capacities

Eltinge Breed, Prof. T. R. Agg, Maj. Fred A. Reimer, W. G. Thompson, W. D. Uhler and Chas. M. Upham.)

In our preliminary report we subdivided our topic into the following heads as being best adapted for our discussion:

1. Width (a) of the Pavement. (b) of the Shoulders.
2. Drainage. (a) Surface. (b) Sub Surface.
3. Foundations. (a) of New Construction. (b) of Previous Construction.
4. Pavement Surfaces.
5. Desirability of Maintaining Traffic During Construction.
6. Economic Improvement of Line and Grade.

The committee realizes that in the choice of these elements for discussion it has restricted the scope of work. The line had to be drawn somewhere, as the topics above may be interpreted broadly enough to cover the essentials of our subject.

Width

The committee reaffirms its recommendation on width, that is, that the paved surface of the roadway on trunk highways should be at least 20 ft. in width. For each additional line of traffic 9 ft. more should be added.

The committee recommends that the minimum of the shoulder be 5 ft., except in cases where new right of way is to be acquired; then the additional width of shoulder should be at least 9 ft., in order that, should additional traffic require it, four lines of traffic may be accommodated without requiring additional right of way.

Drainage

The committee reaffirms its recommendation that the present drainage systems be examined and placed in such condition that they will function properly. Such additions should be made as are necessary to keep the subgrade dry.

We suggest that where under drains are necessary that they be placed along side of the pavement, and not directly under it. The advantage of this method is that they can be cleaned without disturbing the pavement surface, and to a large extent safeguarded from vibration which has a tendency to fill them up. It has been found in many cases that a line each side of the pavement requires less linear feet of drain than a single line with spurs running under the pavement.

Pavement

A. Where of new construction the Committee reaffirms its recommendation that all foundations be of concrete or other suitable material. We do not recommend thickness for the different kinds of foundation because the data in regard to experiments being carried on by the Federal Government is not yet available. Valuable as these will be, we believe that before definite recommendations are made they should be supplemented by reports of traffic census and service conditions on many types of road now in use in order that we may properly anticipate the motor truck need of the future.

B. Where the present pavement can be utilized the Committee recommends that the widening be of the same kind of construction as the portion to be utilized. Where, however, it appears feasible to anticipate future needs, then we recommend that the widening be of a type appropriate to them. It is suggested that when widening a pavement, edging be used to prevent lateral movement.

C. No definite conclusions have been formed as yet with regard to bituminous macadam foundation. The cases that have been brought to the attention of the committee are so limited in extent that the committee is not prepared to make a definite recommendation at this time.

The committee recommends that pavements on trunk line highways be of Concrete, Brick, Wood Block, Stone Block, Asphalt Block, Bituminous Concrete (of the mixed type), or Sheet Asphalt.

The committee wishes to suggest that all detours be made adequate for the traffic that they must carry; that they be maintained during the time of detour and that they be put in passable shape at the completion of the work. The expense of the detours is to be assumed by the governing body doing the main construction work.

The committee, also, suggests that where there are two main lines in the same direction between two centers of population only one should be improved at the same time, in order that traffic may have one through route at its disposal.

We reaffirm our statement that the best possible methods should be used to maintain traffic.

Economic Improvement of Line and Grade

The committee recommends a thorough study of line and grade in order that sharp turns and steep grades may be eliminated at the time of reconstruction.

It is suggested that greater safety may be had by cutting existing banks on the inside of curves, thereby giving greater sight distance. In all reconstruction work curves should be eased to give a greater sight distance.

SAVE MONEY LABOR TIME

THIS IS WHAT

Heltzel "Lightning" Loader Skips

do in unloading material from open cars.

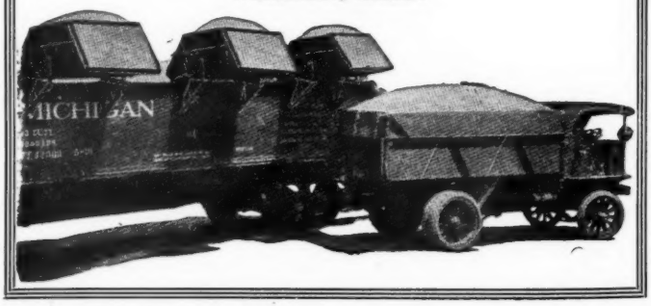
Are YOU paying for idle trucks and idle men? Keep your motor trucks moving and your men busy. One Loader will pay for itself on the first job.

Made in 1 cu. yd. and 1½ cu. yd. sizes.

Send for Catalog.

Heltzel Steel Form & Iron Co.

WARREN, OHIO.



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No. 52

This is Motor Truck Section Number Fifty-two, the fourth number in the **Fifth Year.**

Every month for over four years **Municipal and County Engineering** has published a special Motor Truck Section, consisting of articles and advertisements of interest to truck users, truck salesmen and truck manufacturers.

Through this Motor Truck Section a very great deal has been done to demonstrate the practicability and economy of motor haulage in city and county. No other similar medium has done so much to popularize the motor truck.

For many years this has been the leading highway journal; latterly it has also been the leading motor truck journal in its field. It has pointed the way to the cooperation between motor truck and highway interests which rapidly is giving a real highway system to the country.

To reach workers in the highway field, and in every branch of the great public works field, use **Municipal and County Engineering.**

Advertising rates and circulation figures quoted on request.

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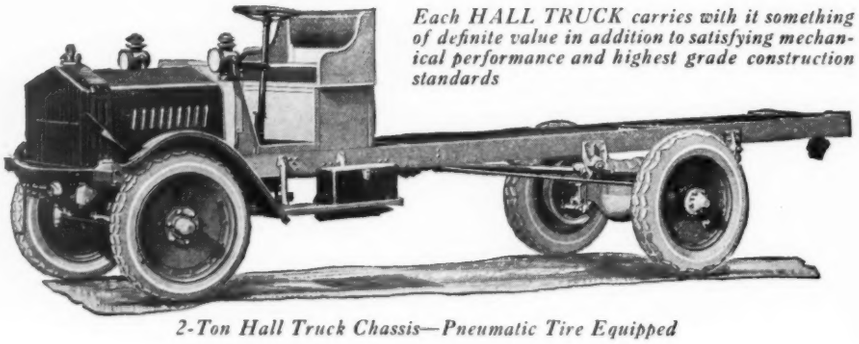
538 S. Clark Street CHICAGO

HAUL IT IN A HALL

ORPHANED TRUCK INSURANCE



Each HALL TRUCK carries with it something of definite value in addition to satisfying mechanical performance and highest grade construction standards

2-Ton Hall Truck Chassis—Pneumatic Tire Equipped

THAT something is—46 years of unbroken manufacturing responsibility, out of which has grown recognized commercial dependability, meaning vastly more to **Hall Truck Owners and Hall Truck Dealers** than surface appearance indicate.

Step by step, throughout all those 46 years, the makers of **Hall Trucks** have been carefully, systematically building institutional Good Will—developing a Trade Reputation, which is now so valuable it is zealously guarded.

Naturally **Hall Trucks** exemplify that Good Will and Trade Reputation to the advantage of both **Hall Truck Owners and Hall Truck Dealers.**

And this half century of uninterrupted manufacturing effort is a safe sign—practical assurance of continuous **Hall Truck** production and **Hall Service**—real insurance to owner and dealer against the costly orphaned truck experience.

Then, any **Hall** owner will tell you that a better truck than the **Hall** has never been built.

Give the HALL DEALER in your territory a chance to demonstrate the true service value of HALL TRUCKS, or, write us direct for descriptive literature and specifications of all models. Address Sales Manager, 19 Roby Street, Detroit, Michigan.

As Manufactured by
The LEWIS-HALL IRON WORKS
DETROIT, MICHIGAN.

EDITORIALS

NOT A DAY TO LOSE

The demand of the American people for the construction of hard-surfaced highways has become so great that the best efforts of the road producing agencies of the country will prove insufficient in 1920, unless every business day of that year is properly utilized. Literally, there is not a day to lose. The year must be one of long days and of intense application to work.

So keenly are these truths appreciated by leading federal and state highway engineers that they are doing all they can to concentrate attention on the importance of immediate attention to every detail of the 1920 highway building campaign that can possibly be handled in advance of the construction season. Field operations of necessity depend on the seasons, but so far as legal, financial and office operations are concerned the construction season of 1920 should be regarded as beginning on the first business day of the year.

Almost like a call to arms in the urgency of appeal are the messages recently sent to all highway workers by highway officials. To a large degree the highway building agencies are to be on trial before the public. The public, having voted the requisite funds for road construction, will demand the production of the roads and will be impatient and intolerant of delays.

Every effort should be made to award construction contracts early. Every road contractor in the country who is equipped and qualified to handle road construction work should have construction work to do as soon as the weather and soil conditions will permit. The contractors will undoubtedly be glad of the opportunity to get set for the season at a very early date. They will appreciate the opportunity to round out their financial plans and their organizations, and to get materials and equipment on the ground ready for use when the season opens. It is for local highway authorities to make this plan possible by awarding contracts much earlier than in former years.

We have before remarked on the practice of pushing the construction season "off center." Because of procrastination in the winter months in the handling of the requisite preliminary work, many good construction days are lost at the beginning of the season. An effort is made to replace the fair, wasted days of spring with the later inferior days of early winter. This plan is not only indefensible, but is a reflection on the construction industry. Let us overcome this early-season inertia. Even the farmer of a generation ago was forehanded enough to grease the harness and fatten his horses in advance of the opening up of spring's work. Surely the workers in the construction field can do more than they have done in preparation for the opening of their busy season.

The people are calling for good roads and they must not be disappointed. There is not a day to lose.

CONTROLLING RADICAL LABOR ON THE COAST

As radicalism in the labor movement began to attract attention it must have been a surprise to many, as it was to us, to note that the excesses of the radicals were so largely confined to the far West. We are fond of idealizing the great West and many of us who have never been west of Kansas are pleased to think of that great region as the unspoiled portion of our country, a place where the simple virtues are still popular. It was surprising, therefore, and a bit disappointing to read of the depredations in that virgin land of the bomb-throwing gentry. But if we lost anything of our regard for the real West when the crimes against law and order were committed out there, we have regained it all in reading how the city of Seattle is gaining control of its radical labor element. The successful plan, described in this issue, is being adopted in other coast cities, where "a new declaration of independence for America" is being made. Every reader will find the article interesting, not only, but reassuring as well. All will admire the workings of the modern vigilance committee known as the Associated Industries. In publishing the article we are departing somewhat from our usual strict adherence to our own field, but this question is one quite as much in the minds of our readers as any other.

WHO ARE THE ENGINEERS?

Who are the engineers? We put the query in this form in preference to: When is an engineer?, as the latter suggests levity, whereas we are quite serious. Yet the second question leads directly to the point.

Assuming that a young man has had academic preparation for an engineering career and that he has also had some practical experience in engineering work, just when does he leave off being an engineer assistant" or a "clerk in an engineer's office" and become an engineer?

The questions asked are largely rhetorical in that they are intended to inspire thought rather than to draw out answers. It has been observed that well established engineers are coming more and more to object to the practice of calling every man an engineer who is attached to an engineering organization and performing any of the minor, technical tasks usually entrusted to the young and inexperienced. The chief

engineer of a railroad, for example, recently objected rather pointedly "to calling engineer employes engineers."

It can scarcely be hoped that engineers will all hold the same views on these questions. However much alike all doctors may look to laymen they do not all look the same to the initiated. The same is true of lawyers. Yet the public knows much of doctors and lawyers as classes of men. This form of group recognition by the public is something engineers are workig for. We do not believe it is going to help engineers to deny the use of the name to the young men; it would only add to the confusion in the public mind to attempt to carry the classification idea too far.

The plan long in vogue will not only be hard to change, but should not be changed. Let engineers use the name "engineer" as they have for the past generation, qualifying it as need be by such words as young, civil, practical, graduate, etc. Let us spend our energies in acquainting the public with the men we have called "engineers," rather than in attempting at this time to draw too many fine distinctions between men engaged on what in general terms and in common usage has been called engineering work.

WHAT ENGINEERS POSSESS IN COMMON

Engineers possess in common the earning power of the ability to render their professional services to the public. Anything that cheapens the price of engineering service lowers the income of every engineer. This fundamental truth has been too long ignored by many engineers of the employing and executive classes.

Take the case of the young railway civil engineer offered only $75 a month by the bridge engineer of the road to take a party into the field and make the surveys for the location of the piers and abutments of a five-span steel bridge. That bridge engineer, and we state an actual case, in "holding down" his subordinate was cheapening the price of his own services.

Our well known desire to see the earnings of young engineers increased has not been only in the interest of young engineers. It falls largely to young engineers to perform what we may call the visible or tangible classes of engineering service. The peculiar working tools of the engineering profession are used almost exclusively by the young men. These surveying and drafting operations, elementary though they are, serve more to identify the engineer than all else combined. Cheapen the price of these services and you cheapen the price of all engineering service. We must all go up or down together.

Our great interest in organization work to increase the compensation of engineers rests on our belief that this is the only way to get results. Engineers who could not be expected to advance their subordinates above the market price should gladly co-operate to increase the market price. This movement, unless obstructed from within, will benefit all in the profession.

REFLECTIONS OF A KETTLE TENDER

It will be remembered by our readers that during the war this magazine did all it could to keep alive a proper interest in public works. While others seized the opportunity to chase the nimble shekle into munition plants, cantonments and shipyards, or appealed to passion in denunciations of the enemy and all his works, we considered it our duty to remind our readers that plans must be under way during the war for use after the war. We kept faith with our field, we think, without opposing in spirit the rulings of our government. The job was not always a pleasant one, and it was everything but profitable, but to the best of our ability we kept our particular "home fires burning." Many have since said that our persistent attention to the public works field during the war did much to insure the great activities in that field after the war.

That it was wise and in the public interest to keep alive during the war the interest in public works programs all will now agree. Of course, we were not alone in our efforts in that direction. Speaking of the activities of state highway engineering organizations during the war, A. R. Hirst recently said in his presidential address to the American Association of State Highway Officials: "We did fight and fight successfully in order that the great highway movement be not utterly crushed in the midst of the manifold demands of war, because we felt that by keeping together the nucleus of a highway organization, despite many short-sighted attacks, we were doing the American people a real service. It was not pleasant work, nor profitable, to those of us who were in the midst of the storm. But it was worth while and the fight was won, even though for a time the production of ukuleles was ruled, by the powers that be, as more important than the production of highways."

In a recent letter to all state highway departments Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, said: "It is a matter in which the State Highway Departments may take a large measure of satisfaction that road building is the one big public activity which got under way early in 1919, which opened a large field for unemployed labor, which offered a market for construction materials and which has continued to increase in volume as the months have passed." There is a summing up of the value of keeping the old kettle hot during the war.

Whatever our part may have been, whether small or great, we have much satisfaction in remembering it and it is gratifying, of course, to know that the wisdom of a course once questioned is now above criticism.

Many "rolls of honor" grew out of the war. We confess that we have one. On it are inscribed, in deathless bronze, the names of those who remained loyal to this magazine during the war. Now that pleasanter times have returned we shall not fail to preserve this, our own, roll of honor.

PREPARE NOW FOR CAPACITY PRODUCTION OF NEW HIGHWAYS IN 1920

By Thomas H. MacDonald, Chief of the Bureau of Public Roads, Washington, D. C.

(Editor's Note: The people have voted to spend hundreds of millions of dollars on the construction of roads in 1920. They expect results. If the people are not to be disappointed every nerve must be strained by all workers in the highway field in preparing for the supreme test in 1920. The following letter from Mr. MacDonald has been sent to each State Highway Department; it contains specific suggestions of the greatest, immediate importance).

It is a matter in which the State Highway Departments may take a large measure of satisfaction that road building is the one big public activity which got under way early in 1919, which opened a large field for unemployed labor, which offered a market for construction materials, and which has continued to increase in volume as the months have passed. It is too early to have definite figures available for this year's production of roads and total expenditures, but it is estimated that the expenditures during 1919 for hard surfaced highways, exclusive of sand-clay and similar types, will total approximately $138,000,000. The largest previous year's total expenditures for like purposes that of 1916, was $136,000,000.

Funds Available for 1920

But the test of the road building organizations is ahead. The estimated summary of the funds which will be available for highway work during 1920 for the construction of surfaced highways is as follows:

Brought forward from unfinished work 1919 contracts	$165,000,000
Funds available from state and county taxes and federal aid	273,000,000
One-fifth state and county bond issues not before available	50,000,000
One-third of the unexpended balance of state and county bond issues previously available	45,000,000
Available from new bond issues to be voted on the fall of 1919 and spring of 1920	100,000,000
Total	$633,000,000

This large total is more than four times the amount of money that has been expended during any previous year for like purposes. To accomplish the physical undertaking of putting into actual road construction this sum, or anywhere near this sum, is tremendous. It is so much greater than any program that has heretofore been attempted that a great increase in the principal factors controlling the actual production of highways is absolutely essential. These principal factors are material supplies, shipping facilities, labor supply and contractors' organization.

Shipping Facilities

The acute deficiency of open top cars demands that our first attention be directed towards increasing shipping facilities for road materials. These facilities may be increased by two methods; first, by the more efficient use of open top car equipment, and second, by a large increase in the supply of new cars. During frequent conferences with the Railroad Administration it has become apparent that a more efficient use may be made of the present open top car equipment by starting the shipping season earlier than has been the general practice in the past. It has been customary to wait until contractors' organizations were ready to begin work before starting the shipment of materials. Under these conditions many thousands of open top cars lie idle during the latter part of February, all of March, and the earlier part of April. In the spring of 1919 the number of open top cars that were idle totaled more than 250,000. As the season advanced and road contracts were actually under way, the car shortage manifested itself here and there almost continuously, but at three different times complaints received at this office were general.

We must recognize that if a strike threatens the railroads, road material will not be moved because it is not perishable. If the movement of coal demands the cars, there will be a shortage of cars for the movement of road materials. The importance of the movement of road materials must be impressed upon the public and the railroads, and for the present the road builders must correlate their calls for service so far as possible with the situation which exists—that at any critical moment when shipping facilities are involved, road materials will be the first to suffer.

Therefore, everything possible must be done to facilitate transportation of road materials under these handicaps. Railroad transportation has become too important a factor in the amount of work that can be accomplished to allow it longer to be regarded as incidental. It has become the biggest item in road production.

Award Contracts Early

Contracts should be awarded as early as possible that the contractors may know the amount of materials they will require at diffierent points and they should be encouraged to place their orders for the materials requiring rail transportation as long in advance of the time they will be actually required as possible. The placing of materials in storage piles involves some expense but this expense is small in comparison to the loss occasioned by lack of materials when the contractors' organization is waiting.

From the experience this year and in view of the greatly increased program for next year it seems apparent that contracts which are not awarded during the winter months will have little opportunity of being supplied with materials which require rail hauling. Again contracts should be awarded early and contractors should be encouraged to place their orders so that the material producers will operate their plants during all seasonable weather. In the past, too many contracts have been held until later in the year and material supplies have not been started moving during the period when the car supply is at its maximum. Also, contract prices have usually been lower for work awarded early in the season, and the State Departments and the Federal Bureau must recognize and respond to the public confidence which has been shown by the appropriations of large sums for highway improvement, by adopting every method that will help to secure the lowest prices and the most efficient expenditure of these funds.

In view of the greatly enlarged program of road construction and the large amount of unfinished contracts which will have to go over because of lack of road materials it would seem unnecessary to further accent the need for taking advantage of the supply of open top car equipment in February, March and April.

It is apparent that many contractors who have not before been so engaged are looking to the highway field, and that the contractors' organizations will be expanded. The labor shortage may in part be met by improved machinery

and equipment, but the transportation and the supply of materials cannot be so readily or quickly expanded to take care of the greatly increased needs. Unless a forward looking policy recognizing these conditions is adopted at once, it is not apparent that a greatly increased production of roads will be possible next year over the miles constructed this year, yet the public is demanding of road building organizations a greatly increased production.

Every official in an administrative capacity in the road building organizations knows that it is common for the public to demand great activity and immediate production of roads as soon as bonds have been voted. The fact that more than four times as much money is available for roads next year than has been true heretofore means that these demands will become intensified and it will be a difficult task to impress upon the public the fact that the production of roads is controlled by factors largely outside of the control of the highway officials.

The only possible relief is to use the present transportation and materials production agencies in the most efficient manner possible, and at the same time bend our efforts to obtain an increased car supply and an increased production of road materials. But these policies, to be effective, must be adopted by the State Department and the Federal Bureau individually and collectively, at once, and the first step is to place under contract during December and January as great a mileage of roads as possible. In doing this the Bureau wishes to co-operate with and aid the States in every way possible.

DESIGN AND CONSTRUCTION OF WORKS IN INTER-RIVER DRAINAGE DISTRICT

By Albert S. Fry, Morgan Engineering Co., 622 Goodwyn Institute Bldg., Memphis, Tenn.

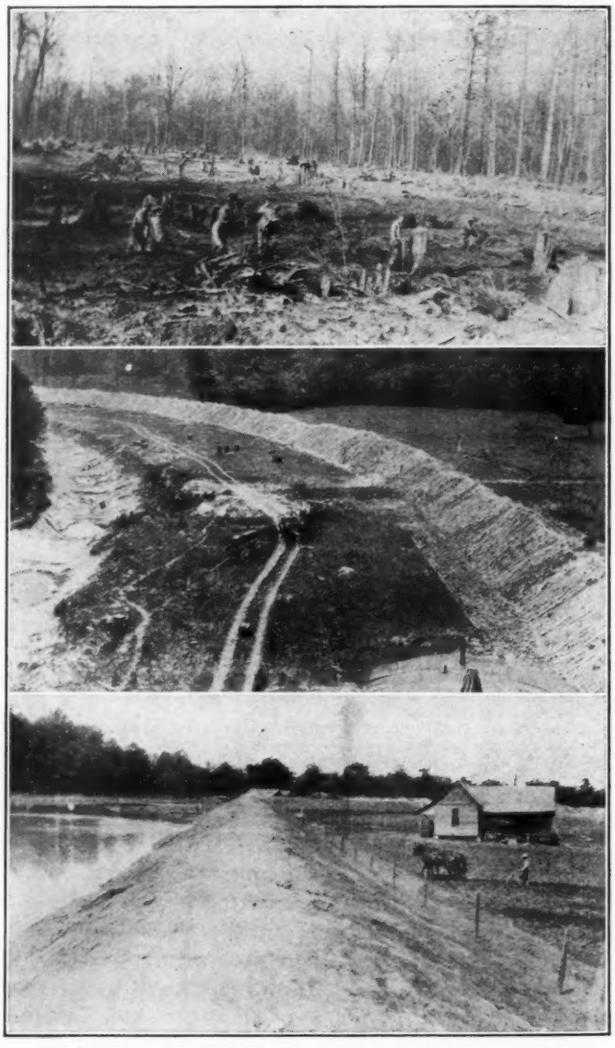
The Inter-River Drainage District of Butler County, Missouri, is among the larger projects which have been undertaken for the reclamation of overflowed lands. The district is located in southeast Missouri, including 127,500 acres of land between the Black and St. Francis Rivers just north of the Arkansas-Missouri state line. The northern boundary of the district is formed by the foothills of the Ozark Mountains. At the present time construction work is going forward in this district, which will be completed within the next few years.

Design

The reclamation of this area falls into two divisions: first protection against floods from the rivers lying on either side, and second, the removal of local surface water.

The flood control problem offered the most difficulties. A few miles north of the upper boundary of the district the St. Francis River leaves the Ozark foothills. Above this point the river has a drainage area of about 1,350 square miles of hill land. The river valley in the hills has a steep slope, and following heavy rains on the headwaters of the river, the water from the hills runs off rapidly. The result is that all of the waters from the hill shed rush out on to the flat lands of the alluvial plane through which the river flows after leaving the hills. The fall in the river through this alluvial plane is flat and the water coming out of the hills finds a channel only large enough to carry about one-seventh of the extreme flood flow. The remainder of the water overflows the channel of the river and spreads out along either side, flooding the adjacent lowlands.

On the west side of the Inter-River District, the Black River has created a situation similar to that of the St. Francis River. Above the district the Black River drains about 1,230 square miles of land, which is hilly in character. Heavy storms on the head waters of the Black



VIEWS OF OPERATIONS IN THE INTER-RIVER DRAINAGE DISTRICT, BUTLER COUNTY, MO.
Clearing Right of Way for Levees.
First Run Levee Showing Borrow and Berm.
Cultivating Land Inside of Levee with Flood on Outside.

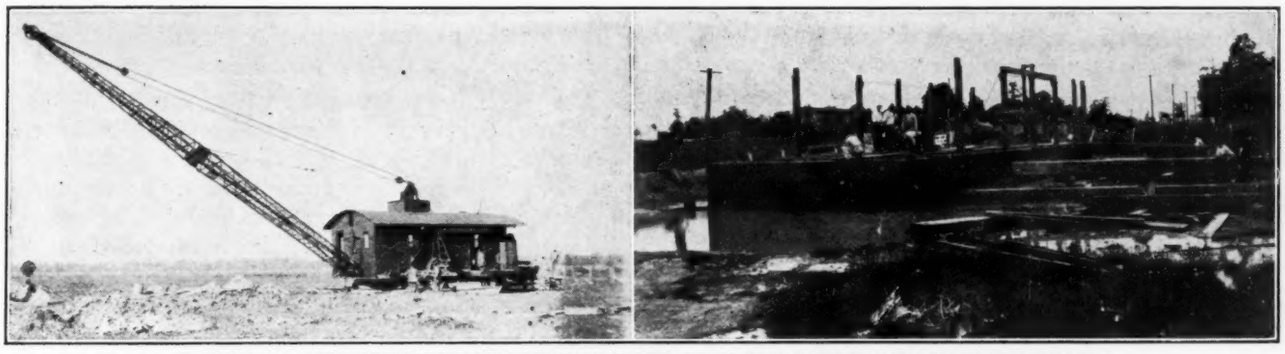
River cause floods in the same manner as those on the St. Francis. The watersheds of the two rivers, lying side by side, tend to produce floods on both rivers at the same time.

In planning protection for the Inter-River District against floods, levees were planned to be built along both rivers which would prevent overflow waters from getting into the district. In the design of the levees along the St. Francis and Black Rivers, the height of levees was designed to allow 3 ft. of free board above the estimated future high water plane. The crown width of levees is 6 ft. and side slopes 2½ to 1 on both river and land sides with the exception of a portion of the Black River

levee where the slopes were made 2 to 1. The average height of the levees varies from 10 to 14 ft. A little more than 54 miles of levee in all are required.

Other methods of flood control, such as detention basins on the head waters of the rivers, floodways, and increased size of channels were all investigated and considered, but none of these proved economical in comparison with the levee system for the Inter-River District itself. If the whole of the alluvial valleys of these rivers had been acting as a unit to secure protection, then the detention basin plan would prove advantageous, but for the protection of the Inter-River District area itself, the size of the district is not large enough to bear the burden of the construction of dams to form detention basins.

The second part of the reclamation problem involved the designing of a system of interior drainage canals to provide local drainage and to furnish outlets for future tile systems. The system designed, and which is being constructed, includes 208 miles of channels. The smaller of these are 12 ft. wide on the bottom and average from 6 to 8 ft. deep with side slopes of 1 to 1. The largest channel, which will be the main outlet channel for the interior system, will be 55 ft. wide on the bottom, 10 ft. deep and have side slopes of 1 to 1. The interior lateral drains are so planned that nearly every acre of land is within half a mile of a satisfactory drainage outlet.



VIEWS OF CONSTRUCTION EQUIPMENT USED ON INTER-RIVER DRAINAGE DISTRICT.
One of the Walking Dragline Excavators—Launching the Hull for One of the Floating Dredges.

Construction

The Inter-River District was ready to let contracts for construction just after the United States had entered the war. The greatest need for the district was the building of the levees to control the floods from the Black and St. Francis Rivers. In view of this need, the Capital Issues Committee, in passing on the district granted permission for the construction of the greater part of the levees. Contracts for the levee work were then let to the Callahan Construction Co. of Omaha, on the basis of a profit sharing contract, details of which require the district to purchase all equipment and furnish all funds for running the job, the contractor managing the work and dividing with the district any saving in the cost of construction below a fixed base price per cubic yard.

After the levee work was well under way, the war ended and the district was free to contract for the remainder of its work. The balance of the levee work and all of the drainage canal excavation was let to the same contractor under an arrangement similar to that for the first levee contract.

The construction of the levees was begun in September, 1918. Four Monighan, 3-T walking drag line excavators were installed. These machines have booms 70 ft. long and carry buckets of 3½ cu. yds. capacity. All of the machines are oil burners and are run by Fairbanks-Morse engines. All four machines are also exact duplicates, so that parts can be interchanged. At a central point in the district, a storehouse and machine shop has been set up. In the storehouse is kept all the supplies necessary for repairs and for keeping machines in operation. Oil tanks have been built to store fuel oil. Portable wooden houses have been built for the men to live in. These houses are so built that they can either be transported on wheels or on runners, depending on the condition of the ground. In supplying the machines with oil and supplies, teams and tractors are both used and on part of the work a barge has been used for taking supplies down the river. Oil is distributed along the right-of-way ahead of the machines in 50 gal. drums.

The greater part of the levee line ran through timbered land and it was necessary to clear the right-of-way for widths varying up to as much as 200 ft. before the levees could be built. Part of the clearing was done by contract work and part by the district's own forces. The heaviest clearing was done by the district itself, in order that the general average price for clearing might not be influenced by reason of high costs on parts of the work which were especially difficult to clear. In snaking logs off the right-of-way, a tractor has been used to good advantage.

In order to secure protection as early as possible from the floods in the rivers, a large part of the levee work has been constructed by first throwing up a levee to an average height of about 8 ft., this being sufficient to protect against the regularly recurring floods, although it would not afford relief from extreme floods. No attempt has been made to crown the first run levee. In throwing up the 8-ft. section, the drag line machine excavated earth from the farthest limit of the borrowpit and placed the material on the outer or river side of the levee, the borrowpits in all cases being on the river side of the levee. In returning to complete the levee, the remainder of the borrowpit excavation is being made, the earth being thrown over the first run levee and joining this so that the full section levee is obtained.

The base of all levees is plowed before any levee material is placed. Where objectionable material is found in the base, the base is stripped to such a depth as the objectionable material extends before any levee material is put in place. Muck ditches are dug below the center of the

levee wherever the levee line crosses low or objectionable ground. Traverses in the borrowpits are left at frequent intervals, the purpose of these being to prevent the flow of water outside of the levee following down the line of the pit and deepening and widening the borrowpit to an extent to endanger the levee. A berm of 30 ft. has been left between the outer toe of the levee and the nearest edge of the borrowpit in most of the work, although wider berms have been used in certain special instances.

In building the levees quite a number of old slough channels have been intersected. These channels at the point of crossing ordinarily are deep and banquettes have been constructed on both the land and river sides at such places. In the case of most of these sloughs, they have served as overflow channels, carrying the waters away from the river and into the district, rather than serving as channels to drain the waters of the district into the rivers. Therefore, stopping the slough channels does not complicate the drainage problem to an appreciable extent.

When the levees are completed, the slopes will be seeded so that the resulting sod will protect the slopes.

The construction of the levees will require the placing of 4,272,000 cu. yds. of earth. At the present time about one-third of this has been constructed. In the interior drainage system 7,225,000 cu. yds. of earth excavation is required. None of this work has yet been done.

To dig the drainage canals, six floating dipper dredges are being built and will soon be in operation. When the drag lines, which are building the levees, have completed their levee work, they will be used on the drainage canal work in addition to the dredges.

The results of the levee construction are already apparent. One of the accompanying illustrations shows a recent high water in the Black River which would have overflowed the land adjacent had not the levee been built. As it was, the levee held out the water and the farmer on the inside was able to plow up to the inside of the levee and carry on his farming operations, altogether oblivious of the fact that the Black River was in flood.

The Inter-River Drainage District was planned by the Morgan Engineering Company of Memphis and the construction work is being carried out under their direction and supervision.

MINERAL AGGREGATES FOR BITUMINOUS PAVEMENTS

By Wallace L. Caldwell, Director Department Roads and Pavements, Pittsburgh Testing Laboratory, Birmingham, Alabama

We are today facing a vital problem which must be solved if the great road building program mapped out for this country, is to be carried out. That problem is the serious shortage of road building materials, particularly of aggregates for bituminous pavements. We must encourage in every possible way, the development of new supplies of such materials, but, at the same time, we must not overlook the quality of these materials," said Mr. Caldwell in addressing the American Society for Municipal Improvements.

This shortage has already resulted in the development of new sources of supply, but the slightly increased production has by no means met the demand. Some of the new materials being sold and used are far from satisfactory and will undoubtedly cause a number of failures within the next few years.

The writer is connected with a large number of current projects and on nearly every contract, difficulty is being experienced in securing sufficient supplies of satisfactory aggregate materials. In order to overcome the delay caused by this shortage, available but inferior materials are being offered. Delays are costly and inconvenient and therefore a decided tendency to permit the use of unsuitable aggregate materials has been noted, both on the part of contractors and city officials. It will invariably be found that the use of such materials will eventually be much more costly than any ordinary delay.

Mineral Aggregate of Greatest Importance

The public and even some city officials consider the bitumen to be the one important element in a bituminous pavement but engineers familiar with pavement construction are aware that the mineral aggregate is of much greater importance. Many failures can be attributed to the use of inferior aggregates, but only a comparatively few to the use of an inferior bituminous cement.

Causes of Failures of Bituminous Pavements

The writer has investigated a large number of failures of different types of bituminous pavement and has endeavored to differentiate the causes and percentages of failure. The percentages given below are not of universal application, but represent approximately the causes of failure encountered in the writer's investigation. The failures considered are failures of the wearing surface as distinct from failures caused by improper subgrade and foundations.

Unsuitable Mineral Aggregate	30%
Improper Manipulation at Mixing Plant	25%
Poor Workmanship on Street	15%
Bad Weather Conditions	15%
Bitumen of Improper Consistency	10%
Bitumen Unsuitable for Paving	5%
	100%

Testing the Aggregates

In spite of its importance, it is only recently that general attention has been given to the physical testing of aggregates for bituminous pavements. Even today most specifications are extremely vague and indefinite as to the quality of aggregate materials. The specifications of the United States Bureau of Public Roads, of several state highway departments, and a few cities have recognized the value of such tests and have made their requirements as definite as the present state of our knowledge of physical testing permits. Hundreds of specifications are being prepared every year, in which even the data available at present is not recognized. The only definite test commonly specified is the mechanical analysis as determined by laboratory sieves. Aside from this test the acceptance of aggregate materials is ordinarily based upon visual examination and personal opinion, both of which have their value, but some more definite standards are needed, especially in these days when many inferior materials are

being used, often under the supervision of men of limited experience.

In this paper only the aggregate materials commonly used in mixed method pavements will be discussed. The essential properties of sand, filler and the usual coarse aggregates will be described briefly.

Sand

Although many able authorities have written upon the essential properties of sands for bituminous pavements, it seems advisable at this time to call attention to some of the salient points regarding sand.

Sand is the water-worn detritus of crystalline rocks and is largely composed of quartz, although calcarious and feldspathic sands are known. It is the writer's opinion, and the experience of others seem to bear this out, that for paving purposes satisfactory results are in general obtained only from quartz sands.

Sands may be classified, as to source, as beach, river and bank sands. A great variety of sands are found in each class, but in general the sands of greatest value are secured from rivers and banks, although many sands from the beaches of the Great Lakes have been used satisfactorily. Sea beach sands are sometimes used, but as a class are not so satisfactory as the other sands mentioned.

Before discussing the physical properties which are necessary in a sand, it may be stated that very little real quantitative data regarding the physical properties of sands for bituminous pavements is available. This is a fruitful field for research and is well worth the time of qualified investigators. Professor Abrams and others ably investigated the properties of concrete sands, and if our knowledge of bituminous pavements is to be advanced it is essential that similiar investigation be made as to essential properties of sands for use in bituminous pavements. This is a complicated field of research which offers many practical difficulties, but nevertheless the problems which need solution can and will be solved.

The writer is glad to report that certain investigations have been under way in his laboratories for some time and that progress is benig made. In due time results will be secured which will be of value.

In the meantime we can best secure satisfactory results by availing ourselves of the information which has been accumulated through experience and observation. Although this information is largely empirical, it serves as a useful guide.

Angular Sand Grains Are Best

Both theory and experience have shown that sands having angular grains are best suited for bituminous pavements. Rounded grains do not have as many points of contact as angular grains, and therefore a mixture in which such grains are used is not stable and is more readily displaced by traffic than a mixture containing angular grains. This applies to sand used in both fine and coarse aggregate pavements.

In order that a film of bitumen, of sufficient thickness, may adhere to each sand grain, the surface of the grain should be somewhat rough or pitted. Sands with smooth and polished grains are frequently encountered but their use should be avoided because the individual grains are sometimes so thinly coated with bitumen that a proper bond between the different particles of the mineral aggregate cannot be secured.

The sand grains should be hard and tough, so that the individual grain will not readily wear away under the abrasion of traffic and fracture under impact. Of course, the small size of the sand grains and the cushioning action of the bituminous cement so largely reduces the danger of fracture that toughness is a much less important factor than in the case of aggregate of larger size, such as gravel and crushed stone. Several failures have been attributed to the use of sands with soft grains. As yet no satisfactory means of ascertaining the hardness and toughness of sands have been devised. There is, however, a need for such tests, and in connection with the investigations previously mentioned, the writer has developed certain methods for making these tests. Before arriving at any definite conclusion as to the value of these tests it will be necessary that many check tests of several hundred different sands be made.

Impurities in Sand

The amount and character of the impurities found in sand largely determine its value. Clay, loam, mica and organic matter are common impurities, and in sufficient amount each one is a most important factor in determining the quality of mixture.

Clay is found either finely divided and evenly distributed through the sand or in the form of small clay balls. If only a small percentage of clay is present in a finely divided state and the clay itself is not plastic, little harm will be done, in fact, a large percentage of the clay will be removed by the fan on the heating drum of the asphalt plant. However, if the clay is plastic and present to the extent of more than 5 per cent. the sand grains will be coated with a hardened film of clay, after pasing through the drum. This film will prevent the bitumen from adhering to the actual surface of the sand grains. The film of bituminous cement is easily broken away from the sand grains, permitting water and traffic to disintegrate the pavement.

Clay balls, when present in any appreciable quantity, are a source of even greater danger than evenly distributed clay, and engineers should take a decided stand against the use of sands containing such material, because disintegration is quite certain. The clay balls at the surface of the pavement are removed by water and traffic. This allows water to work down into the pavement gradually softening the clay balls scattered throughout the mass. Eventually this results in serious disintegration of the pavement surface. This condition is of more common occurrence than is often realized.

Mica in Sand

In certain sections of the Country where the sands have been formed by disintegration of granites and gneisses, mica is almost a universal constituent of the sands. If present in any appreciable amount, trouble may be experienced, since the mica grains cannot be satisfactorily coated with bitumen and will not resist traffic. In practice the writer has ordinarily rejected sands containing over 3 per cent. of mica, as estimated with the microscope. Organic matter, usually in the form of roots, twigs and leaves, is found in many sands. When the hot sand is screened through an 8 mesh screen, as in the case of sheet asphalt, the greater portion of such material will be removed, but when the type of pavement requires the use of a larger size screen, the roots and twigs will pass through

into the mixture. Such material in the mixture is a source of weakness and either the sand containing it should not be used or else it should be screened out.

Grading of Sand

The grading of sand is, of course, one of its most important properties. In fact, experience and theory have demonstrated most clearly that the grading must be within certain narrow limits if satisfactory results are to be secured. Sand is used in several types of pavement, both by itself and combined in various percentages with several kinds of coarse aggregate, but in every class of pavement the grading of the sand is an important factor. From the standpoint of the practical asphalt man, sands are often classified as fine, medium and coarse.

The fine sand contains a high percentage of 100 and 80 mesh grains, the medium a high percentage of 50 and 40 mesh material, and the coarse a preponderance of 30, 20 and 10 mesh grains. In most sections of the country, medium and coarse sands of proper quality are more readily secured than the fine. Sands containing a sufficient percentage of the fine 100 and 80 mesh grains must be found since without these fine grains a satisfactory pavement will not be produced, regardless of the type of pavement.

An engineer is fortunate indeed who can find one sand which will fill all requirements as to grading. Such sands are found but they are rare. Ordinarily mixtures of two, three, and even four sands must be made in order to produce a properly graded aggregate. Specifications customarily fix the percentage of 200 mesh sand at a maximum of 5 per cent. This limitation is based upon sound reasons and should be invariably followed, in fact, it has been the writer's practice, to limit the 200 mesh sand to 3 per cent. whenever possible. The 200 mesh material in a bituminous mixture should be composed of filler, and not sand. Sand grains even though they pass the 200 mesh sieve are much coarser than the greater portion of a properly ground dust and do not function as a filler in any respect. Sands containing up to 10 or 12 per cent. of 200 mesh grains have been used with little or no filler, it being assumed that since the percentage of the 200 mesh material was within the required limits, no other material of this size was needed. Such mixtures are unstable and invariably result in failure.

Investigate All Sources of Supply

Too frequently, the sands most readily available, even though not entirely satisfactory, are used. Usually a brief investigation and a sand survey will locate other supplies within reasonable shipping distance. Quite commonly the new supplies will be better than those previously available, particularly in those regions where suitable sands have not been developed, owing to lack of demand. Before deciding upon the sands to be used on any job the writer has invariably investigated all possible sources of supply, both developed and undeveloped. The results obtained have usually justified these investigations.

Filler Requirements

Filler, which is finely ground mineral dust, is ordinarily used in all types of mixed method pavement, except bituminous concrete pavement with a mineral aggregate of crusher run stone or pit run gravel. Its use produces a dense pavement, reduces liability of displacement, enables a softer asphalt cement to be used, and causes the surface to be less susceptible to damage from water.

An ideal filler should be finely ground, not merely so that a considerable percentage will pass a 200 mesh sieve, but so that at least 60 per cent. will be a true dust or impalpable powder, as determined by the elutriation test. It is this powder which really serves as the filler and which produces the results required of a filler. The remaining portion of the filler simply serves as sand. The grains of the filler should have a surface which will absorb a heavy film of bitumen. Very hard dense grains do not absorb a sufficiently thick film of bitumen to permit such grains to fulfill all the functions of a filler even though the material be ground to the requisite fineness.

The filler should be so constituted, chemically, that it will have no harmful action upon the bitumen and so that water will not in any way react with the material. The material should not be light and fluffy but should have a weight of at least 90 lbs. per cu. ft. Lighter materials are readily blown away when being placed in the mixer, with the result that the mixture has a variable and always low percentage of filler. Closed mixers eliminate this difficulty but are found on only a few plants. Light weight fillers, when used in sheet asphalt often produce a fluffy mixture, which will not rake well and which does not take compression as it should.

Portland Cement Fillers

Among the fillers commonly used, are Portland Cement, Ground Limestone, slag dust and ground silica. Nearly every kind of pulverized mineral has been used at one time or another. Practice has clearly shown Portland Cement to be the most successful filler and Limestone dust to be relatively second in value. Portland Cement seems to produce a somewhat denser mixture than any other filler and when heavy traffic must be provided for, its use is advisable. The reason for this is somewhat obscure, but principally is due to the slightly porous nature of the Portland Cement grains. This property results in each grain absorbing a certain amount of bitumen and permits the formation, around the grains, of a tenaciously held and rather thick film of bitumen.

Limestone dust has been used with entire satisfaction. Slag dust, has not been extensively used but has given good results wherever used. It would not be advisable to use the dust from an acid slag, because of the hard, glassy nature of the material, but no criticism can be made of the dust from a basic slag. Silica dust, from a number of different sources, has been widely used. No serious trouble has resulted from its use but in general it has not given as good satisfaction as certain other materials.

Good filler is scarce today, the production having fallen below the demand. Many products, which cannot be classed as a dust in any respect are being offered. Products having 50 per cent. of material passing the 200 mesh sieve but containing very little actual dust, as determined by the elutriation test, are not uncommon. In several cases agricultural limestone containing 20 or 25 per cent. of 200 mesh material with coarse grains as large as ¼ in. has been used and has been called filler. Ground stone such as this contains no true dust and simply serves as a source of fine and intermediate aggregate, with the result that the mixture contains no filler.

Rock Requirements

Limestone, Dolomite, Trap Rock and Granite are the rocks most commonly used in bituminous construction, although sandstone, gneiss, and certain other rocks have been used to a limited extent. The rock should be sufficiently hard to resist the abrasive action of traffic and tough enough to withstand the impact of iron-shod hoofs and of vehicles. It should be clean and free from clay. If the rock contains fine screenings it should be freshly crushed, since the dust tends to collect on the surface of the larger pieces and, if, once wet, forms a scum on the surface, which is dried and baked when the stone is passed through the heating drums. This film effectually prevents the adherence of the bitumen to the surface of the rock. The individual pieces should be as nearly cubical as possible, since stone which crushes in slabs or slivers produces a mixture which cannot be compressed to as great a density as if a stone of cubical fracture is used. Slabby pieces of stone are more easily fractured by traffic and thus are likely to cause the pavement to ravel. A stone having a structure and surface which will permit of absorption of a certain amount of bitumen is to be preferred to a stone with a hard, dense surface which will permit of no impregnation.

Physical Test for Rock

Fortunately satisfactory physical tests have been devised for rock. The U. S. Bureau of Public Roads and others have made thorough investigations of the methods and interpretations of these tests. Hubbard & Jackson in Bulletin 370 U. S. Department of Agriculture have tabulated a great amount of data and have given valuable interpretation of the results of their tests. Too few specifications call for these tests and it would seem advisable for the Society to make a study, through a proper Committee, of the definite physical requirements which should be specified for the different classes of bituminous pavements under all conditions of traffic and climate found in Muncipalities.

Requisite Toughness

It has been the writer's experience that for City pavements, subjected to ordinary traffic, no rock having a French Coefficient of wear of less than 8, or a toughness of less than 8 should be used. Under very light residential traffic it is sometimes permissible to permit the use of a rock wth a toughness of 7, and French Coefficient of 6, but under no circumstances should an aggregate of lower value be used. For heavy City traffic the requirements should be increased to a French Coefficient of wear of at least 10 and a toughness of between 10 and 14 depending upon the density and nature of the traffic and the size and character of the aggregate. Binder stone should have a toughness of at least 7. Of the two tests toughness is undoubtedly of the greater value when considering the quality of rock for a bituminous pavement.

The grading of the crushed stone is of vital importance and in bitulithic and asphaltic concrete pavements is given careful attention. The density of any coarse aggregate mixture is dependent upon the proper grading of the stone. In some cases, stone as received from the quarry may be of the proper grading but often a combination of crushed stone of different sizes must be used. In bitulithic pavement the stone is screened into various sizes, each size stored in a separate bin and recombined in the proportion desired, by weighing a definite amount from each bin.

Chats or Trailings

Since their use is rather widespread it will be well to mention chats or trailings from certain ore mines. The two materials of this class most commonly used, at least in the eastern half of the country, are from the zinc mines of eastern Tennessee and the Joplin, Missouri, District. The Tennessee chats are a limestone, averaging 97 per cent. Calcium carbonate are very hard and tough, have an unusually high specific gravity, and a decidedly cubical fracture. The surface of the pieces of rock is perfectly clean, washing being a part of the ore dressing process. Most excellent results have been secured from this material. The Joplin Chats are a flint, are hard and tough, have a good cubical fracture and are clean, but have a very smooth surface which does not hold a thick film of bitumen. However, excellent results have been obtained in many pavements with these chats. In the process of manufacture both materials are so crushed that they will pass a 2 mesh sieve. They are, therefore, used almost entirely in Asphaltic Concrete Pavements of the Topeka type.

Blast Furnace Slag

Crushed blast furnace slag has in the past been used to a limited extent in the wearing surface of bituminous pavements. Its use is increasing and it has been recognized as a satisfactory aggregate material used by a number of cities and counties, and at least one state highway department, that of Ohio. Slag has been used in some bituminous pavements for several years with apparently good results. The writer has had certain pavements in which slag aggregate was used, under observation for the past 2½ years. No trouble which can be attributed to the slag has developed as yet. Two general classes of slag are available, basic, containing a high percentage of lime and magnesia and a relatively low percentge of silica, and acid, containing a higher percentage of silica. Basic slags are tough and hard, whereas acid slags are often brittle. Basic slags have a porous and somewhat absorbent surface; acid slags have a glassy surface, which is unsuited for bituminous pavements. Ordinarily basic slags only should be used. The following are typical analyses of the two classes of slag.

CHEMICAL ANALYSES OF TWO CLASSES OF SLAG

	Basic	Acid
Silica	35.55	39.50
Alumina	12.04	14.00
Iron Oxide	.62	.52
Calcium Oxide	41.35	40.00
Magnesium Oxide	8.45	4.00
Total Sulphur	1.28	1.32
Physical Tests		
French Coefficient of Wear	6.2	3.6
Toughness	14.0	6.0
Hardness	15.6	15.5

Slag is more difficult to test than rock due to greater difficulty in securing representative and suitable samples for some tests, but usually the methods of testing used for rock meet all requirements. Slag should not be too badly honeycombed and should be clean and free from blast-furnace down-comer dust. It has been thought by some that possibly some constituent of slag is harmful to the bitumen. Sulphur is usually the constituent blamed, but it is clear that there is no sound reason for this opinion.

Gravel

Gravel has been used as a coarse aggregate in nearly every type of bituminous pavement. Because of the nature of the material and the characteristic rounded grains, it does not give as satisfactory results as a crushed stone. When crushed stone is used, the angular fragments will key together and the results will be better than if rounded gravel is used.

Many gravel deposits contain clay either evenly distributed or in the form of clay balls. The results will be about the same as in the case of sand containing clay.

Toughness and hardness tests are not made on gravel, but the coefficient of wear is determined either by the Deval method used for rock, or by a modified method in which six cast iron spheres 1.975 ins. in diameter and weighing 0.95 lb. are placed in the cylinder with each charge. The French coefficient of wear on a good gravel will be about 12. The mechanical analysis of gravel is of great importance and every effort should be made to keep the grading within the proper limits for each type of pavement.

HIGHWAY BRIDGES OF STEEL AND CONCRETE

By Charles D. Snead, Bridge Engineer, Department of Public Roads, Frankfort, Ky.

Engineers and laymen who are connected with courts, boards or commissions are deeply interested in the cost of bridges, the selection of the proper type of structure, how to secure good work and what is necessary in maintenance to preserve the present structures and prevent deterioration of future structures.

we can estimate accurately—or for that matter, approximately—the cost of a structure, we must have a plan that fits the particular conditions from which to estimate.

Influence of Local Greed on Costs

There is one element which enters into bridge construction which is often overlooked and yet is of vital importance. Local parties, desiring to make a small fortune at the expense of the corporation, state or contractor, will often raise the price of materials and gouge the public and contractor. This is a large reason why contractors will bid high upon the work and why people oftentimes complain of costs. For example, at the time a survey was made in one locality, 3 cts. per cu. yd. would have bought gravel and sand and teams could then be secured for $5 per day. Six weeks afterwards the same sand and gravel went up to 50 cts. under the same identical conditions and the cost of teams to $8. These men were the same highly respected, church-going, sanctified citizens who, while professing to be thoroughly interested in public improvement were interested in the improvement only insofar as they could dig into their neighbor's pockets.

Then the people wondered why the estimate was too low and criticized the engineers for being impractical theorists.

Estimating Costs

In estimating the cost of a bridge, the unit cost of every item must be carefully approximated. The cost of cement delivered, the cost of sand, stone or gravel, labor, the cost of form lumber, together with a knowledge as to whether this could be again used, the cost of excavation, the cost of finishing and protecting the work and the cost of hauling—all of these must be carefully estimated, and finally, a reasonable profit must be figured for the contractor.

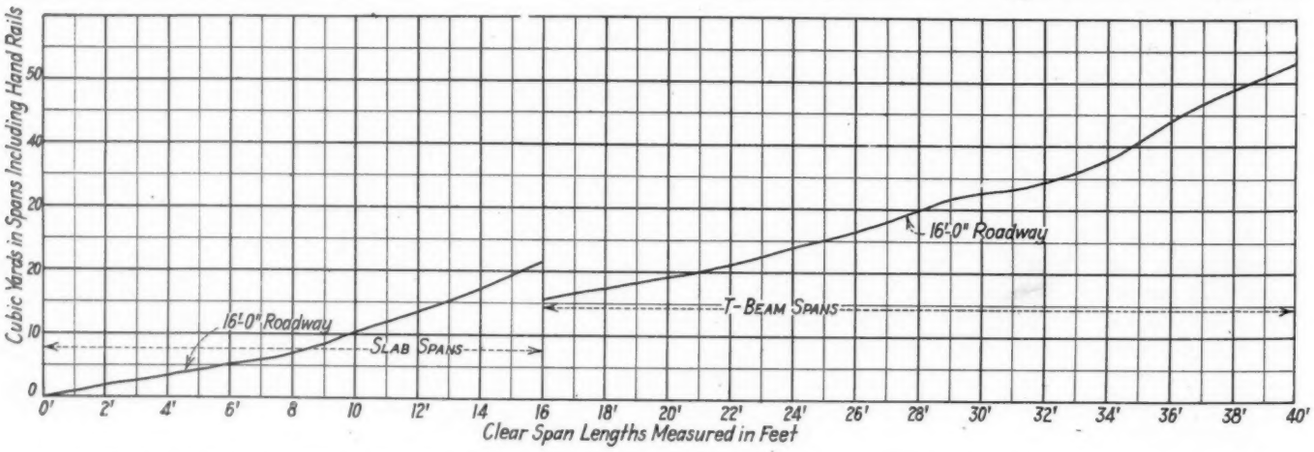


FIG. 1. DIAGRAM SHOWING APPROXIMATE AMOUNTS OF CONCRETE IN SUPERSTRUCTURES ONLY, FOR USE IN ESTIMATING QUANTITIES IN REINFORCED CONCRETE HIGHWAY SPANS.

In approximating the cost of any structure, it is necessary first to know as far as possible all local conditions. This information is secured at the time of making the survey and the more time spent in determining true foundation conditions, availability of local building materials, labor conditions, condition of roads for hauling, cost of teams, storage facilities for supplies, co-operation of the landowners, officials and people in general, is time well spent and will be many times repaid to the company, county or state, both in accuracy of the estimates of costs and in the preparation of the final design. Again, before

When this is done for all items, then without great discrepancies we should be able to approximate the cost of a structure if we know the quantities involved.

From the accompanying curves we may quickly approximate the yardage and tonnage of steel in concrete spans with 16-ft. clear roadway.

The yardage in plain abutments will be approximately the same for steel and concrete structures (greater for steel structures). This yardage may be approximated roughly by multiplying the height in feet from crown of roadway to the bottom of foundations by the following

amounts: (the yardage including wing walls and represents two abutments for 16-ft. roadway spans):

For abutments up to 10-ft. multiply height by 10.
For abutments between 10-ft. and 15-ft. multply by 14.
For abutments 15-ft. to 20-ft. multiply by 15.
For abutments 20-ft. to 30-ft. multpily by 19.

The yardage in plain piers for 16-ft. roadway spans may be roughly approximated by multiplying the height in feet from top of pier to bottom of foundation by 3.3. These figures will give values far closer than mere guesses.

For steel structures designed to carry a 15-ton tractor and a concrete floor, we may estimate the weights of the structure without sidewalks by Kunz's formula and the added cofficient "X."

$$W=(0.12L+12)\ (1.6—0.03B)\ BLX.$$

Where W equals weight of steel in pounds.

Where L equals length of span in feet.

Where B equals width of roadway in feet.

Where X equals 1.7 for high rivetted trusses (85 ft. to 170 ft. for 16-ft. roadway).

Where X equals 1.43 for high pin connected trusses (140 to 200 ft. for 12-ft. and 16-ft. roadway).

Where X equals 1.67 for high rivetted trusses (85 ft. to 170 ft. for 12-ft. roadway).

Where X equals 1.6 for low rivetted trusses (40 ft. to 80-ft. for 12-ft. and 16-ft. roadway).

In Defense of Heavy Construction

It should be remembered if structures built of steel are properly maintained there is no reason why they should not last for 30 or 40 years, perhaps longer. The public has been fooled so long by the old-time representatives of bridge companies about the capacities of bridges that many officials, and engineers too, are at sea and believe the statement that the plans of state departments are designed for too heavy loads and weigh too much.

What man 15 years ago would have predicted the present highway loads? What man dreamed then of fleets of 5-ton trucks, each when loaded to capacity weighing 10 tons and which, by actual weight, have been often found to be 50 per cent. overloaded? What man can definitely state that in the life of bridges no such loads will ever be of frequent occurrence? No man can make such statements without a large probability of being badly reversed in years to come. Again the extra weight in the state spans doesn't all come from the live load they carry. No one doubts but that the old type of wooden floor is doomed. At best, wooden bridge floors are expensive and costly to maintain. We know concrete is heavier than wood and naturally requires more steel to carry this added weight. But there is added weight to the state plans to add to the life of the bridge, added years of service at a very small first cost by the elimination of poor details, thin plates; yes, plates thinner than one-fifth of an inch—details which if neglected rust out and destroy the strength of the whole structure.

The Substructure

There are many men in responsible charge of work who not only are wholly ignorant of the design of masonry abutments and piers and foundations, but who gloat over their ignorance and term it "practical." They build year in and year out abutments founded on sand, mud, soapstone, blue clay, etc., too thin to stand and give service even if founded upon solid rock. These structures stand as monuments to their judgment sometimes for five years, sometimes longer, but more often less, and then—without warning perhaps—fail; proving again that it is the exception which proves the rule. In 14 years' experience I do not remember of more than about one dozen structures in which the substructure when properly designed and placed did not more than exceed the cost of the superstructure. The first costs of bridges can be made cheaper by defying the laws of nature, by omitting piles and not securing the proper foundations and at the same time the treasury can be depleted in the rebuilding and maintenance of such structures.

Maintenance

There is one point upon which too much emphasis can not be laid. The first cost of a bridge should not govern its type; that is, whether the structure is to be of steel, concrete or wood. Structures must be designed and constructed not only with sufficient carrying capacities to care for modern traffic, but also so that the yearly maintenance charges will be a minimum. This cannot be determined without estimating maintenance charges.

In general, it will be found, for spans up to 40 ft., unwise to construct them of steel when the permanence of concrete is considered. This does not mean that longer bridges made up of short spans may not be economically constructed of concrete, nor that concrete arches should not and must not be built for the longer spans.

Maintenance costs vary greatly. They depend upon labor, local material for bridge floors, the kinds of structures, nature of the stringers, whether wooden or steel, and other factors. For these reasons each case must be decided upon its merits and while much data has been collected regarding such costs, this data has not been so arranged as to be of general application under varying conditions. With a wooden floor and steel stringers, an allowance of 5¾ cts. per year per square foot of structure will not prove excessive, and this should at all times be added with interest compounded in estimating the final cost of a steel structure, and then the life of the steel structure should not be estimated over 30 years in comparison with concrete with a life based at 50 years. If the difference is slightly in favor of a steel structure, remember we are dealing with approximations and build with concrete.

Contractor and Inspector

The secret of good workmanship is simple, intelligent inspection of your work and the employment of a good contractor. Good work costs money. Avoid the contractor who is always anxious to tell you how your work should be done. This man is in business for himself and he probably thinks you are ignorant. If he can do something cheaper and make more money for himself, he will tell you. It is money he is hunting. Get a contractor who has been doing the class of work desired; get an intelligent inspector, one who knows his work and good workmanship will result. Plans will be followed without "ifs" and "ands." In the selection of your inspector, pick a trained man, if you can find one thoroughly experienced, but in all events choose an experienced man. If he follows the specifications and knows good work, there will

be no doubt as to the final appearance of the structure.

Just a few words about maintenance. Concrete bridges require practically no maintenance but must be inspected to see that there is no scouring action, to see that the cushions have not worn through and that drain holes are open and operating. These things should be attended to immediately. The tops of concrete structures should always be finished off smoothly without pockets to hold water and should be sloped or rounded to drain it off. This will prevent the water standing on the structure causing the cushion to become muddy and also prevent the water from being absorbed by the concrete.

Inspection of Steel Bridges

Steel structures must be regularly inspected. If spots need cleaning and repainting this should be done and possibly for a period of a year or more repainting the entire structure may be delayed without damage to the structure. When repainting is necessary, do not allow the structure to continue to rust through the idea that the money can be saved until another year. You are paying dearly in interest in the life of your structure. Have your structure thoroughly cleaned before repainting and use only the best paints for your work.

Inspect your bridges with concrete floors and see especially if they are the arch type of floor commonly found in this state, whether or not they have not punched through. If the structure contains a wooden floor inspect closely for decayed planks. Decay is a disease and will travel from one plank to the other if they be in contact and neglected. Do not put concrete floors upon bridges designed for wooden floors; they are weak enough already, no doubt, for modern traffic. Inspect abutments for movement, and if movement is taking place, get an engineer to advise you what to do. Evidence of movement may be indicated by buckling hand rails or bottom chords or by the pier or abutments leaking.

In conclusion, if bridges are designed of equal strength according to the same specifications, it should be remembered their costs will be approximately identical. When you cheapen your first cost, be sure that you have not lessened the strength nor the durability of the structure. It is possible to reduce the cost of structures by temporary or makeshift abutments which surely will fail in time. It is possible to put in thin metal and poor details and reduce the cost at the expense of the life of your structure and it is possible to reduce the safe carrying capacities of spans and eliminate cost. None of these can be recommended. If your structures seem bargains, it is well to see from what portion the moths have taken their meals. Kentucky will stand for any amount of money properly expended, getting a dollar value for a dollar. She will not stand for waste of her funds in worthless bridges, and there will come a day when the people will fully realize modern traffic is delayed, not by muddy roads, but by bridges bought not for what they were, but for what they cost.

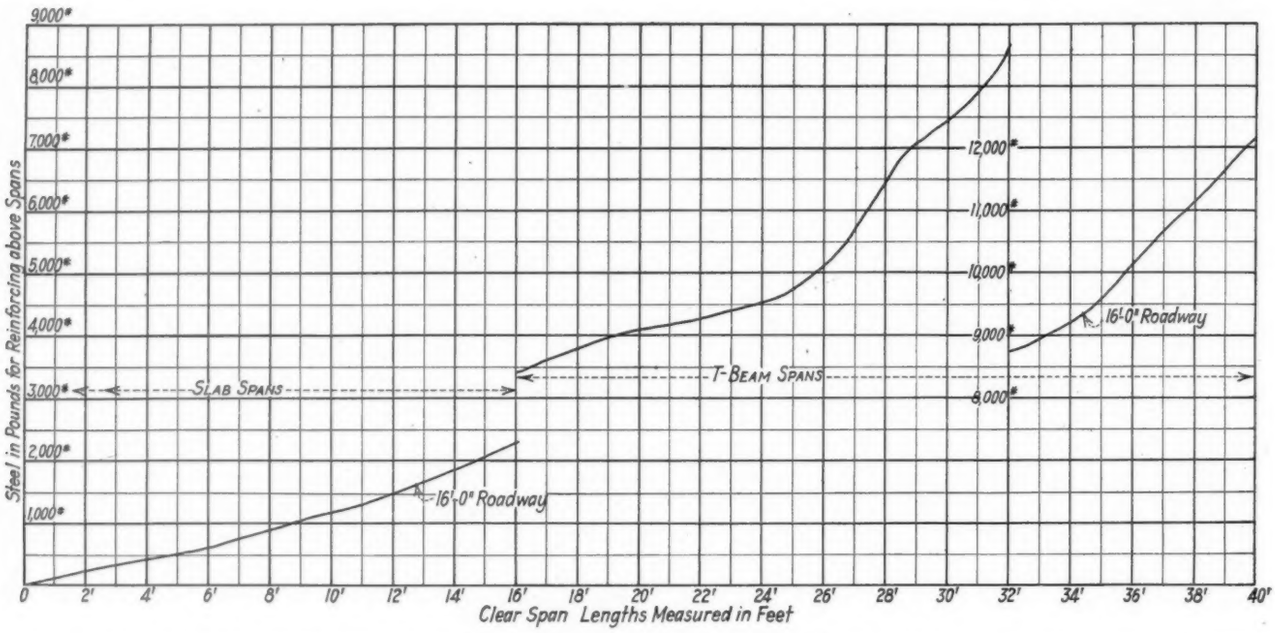


FIG. 2. DIAGRAM SHOWING APPROXIMATE AMOUNTS OF STEEL REINFORCEMENT FOR ESTIMATING QUANTITIES FOR SLAB AND T-BEAM SPANS WITH 16 FT. ROADWAY.

Acknowledgment

The foregoing paper by Mr. Snead was presented before the Kentucky Highway Engineers' Convention at Owensboro, Ky., on Nov. 14, 1919.

THE PROPOSED NATIONAL DEPARTMENT OF PUBLIC WORKS

By W. B. Gregory, Tulane University of Louisiana, New Orleans, La.

Do we need a Department of Public Works? This question is now before Congress, and the attitude of the engineers of the country should be a large factor in its solution, said Mr. Gregory in addressing the American Society for Municipal Improvement.

Several departments of the National Government have overlapping interests. Instances of mutual working

agreements are comparatively rare. Each department has its own rules and regulations, its own ideas, specifications, methods and specific objects. The race for departmental supremacy is often as prominent as the object to be attained by official activities. The overhead charges, the duplication of efforts, the cross purposes, the multiple accounting and the technical and clerical help, the duplicated property and equipment, duplicated traveling expenses, all tend to increase the cost and lower the efficiency of the work as a whole.

Since the Conference of Engineers, Architects and Constructors was held in Chicago, April 23-25, 1919, the technical press of the country has published a great deal of information regarding the proposed National Department of Public Works. The purposes of the conference are therefore known to the technical men of the country. They will bear repetition until the hope becomes a reality.

The conference was called by the Engineering Council, representing the four great Founder Societies.

At the conference 84 societies were represented, the total membership aggregated 105,000 engineers, architects, constructors, chemists and geologists.

There was remarkable unanimity among the delegates, as all agreed on the desirability of a grouping of the Public Works of the Government under one head. Only in minor details were there differences of opinion.

The Jones-Reavis Bill

The bill, S-2232, embodying the results of the conference, was introduced in the upper house by Senator Wesley L. Jones, of Washington, and in the lower house by Representative Frank G. Reavis, of Nebraska, July 25, 1919.

The bill proposes far-reaching changes in the executive machinery of the federal government. The Federal Department of the Interior will become the Department of Public Works, if the legislation proposed is enacted. The main idea is to assemble all engineering activities of the Government in one department.

Such bureaus of the Interior Department as are non-engineering in character are to be placed under the jurisdiction of appropriate departments, while engineering bureaus from other departments are to be included in the Department of Public Works. The bill proposes that the Patent Office is to be removed from the Interior Department and placed under the Department of Commerce. The Bureau of Pensions is assigned to the Department of the Treasury. The Bureau of Education goes to the Labor Department. The Bureau of Indian Affairs is also assigned to the Department of Labor, with the proviso that the engineering and construction work and the land and mineral surveys now performed under the direction of the Bureau of Indian Affairs are to be prosecuted under the Department of Public Works. St. Elizabeth's Hospital and the Freedman's Hospital in Washington are assigned to the Treasury Department. Columbia Institution for the Deaf and the Howard University go to the Bureau of Education under the provisions of the bill.

On the other hand, the Department of Public Works is slated to absorb the Supervising Architect's Office of the Treasury Department; the Construction Division, River and Harbor Improvements, Mississippi River Commission and California Debris Commission of the War Department; the Bureau of Standards and the Coast and Geodetic Survey of the Department of Commerce; the Bureau of Public Roads and the Forest Service of the Department of Agriculture.

The Public Health Service is to remain, temporarily, under the Treasury Department, although some were of the opinion that it ought to go to the National Department of Public Works. The bill will probably not pass as written. There will be much discussion and probably some changes before it becomes a law.

The Secretary and Assistant Secretaries

The bill provides that the Secretary of Public Works "shall, by training and experience, be qualified to administer the affairs of the department and to evaluate the technical principles and operations involved in the work thereof." The measure excepts from the foregoing provision the Cabinet officer who is at the head of the Department at the time of the passage of the bill.

Four assistant secretaries, each to be paid $7,500 per annum, are provided and their duties outlined. One assistant secretary is to have administrative jurisdiction over all matters of engineering design and construction. Another is to have charge of architectural design and construction. The third is to have jurisdiction over all scientific work and surveys, while the fourth assistant secretary is to be in immediate charge of all land and legal matters. The assistant secretaries are charged with the duty of co-ordinating and bringing into efficient relationship all the activities of the department so that it may be harmoniously and efficiently administered.

An important feature of the bill is the proviso that the engineer officers of the U. S. Army detailed on non-military work are to be assigned by the Secretary of War to like duties under the new department for not over two years. This enables the Secretary of Public Works to make gradual transfer of improvements and instrumentalities to civil administration without detriment to public interest. Members of the Corps of Engineers may, under the direction of the Secretary of Public Works, be detailed by the Secretary of War to temporary duty in this new department for such instruction, training and experience as is desired.

Need for the Department

The case briefly stated is as follows: The United States Government is annually engaging in public works that may be classified under the heads of engineering, architecture and construction; in many instances the work of one office overlapping another, resulting in lack of efficiency and waste of public funds. This state of affairs is the natural outcome of the rapid development of the country, the growth of interests and offices that were ever expanding.

Has not the time arrived to group all of the engineering activities of the United States under one head—to turn over this work to the specialists,—to effect economies by preventing duplication of work and overlapping of projects? When the finances of the country are under discussion we turn to the experts in finance. When in need of legal advice we consult the lawyers. When we are ill we call in a physician. If satisfied that self interests are eliminated, we are willing in general, to follow the experts

who have given mature study to a particular line. Engineers and architects are professional men, highly trained in particular lines. Most of them are college graduates in courses that are quite as difficult as those of any other profession. They deal with the eternal laws of the universe and the application of forces and materials to the betterment of society. It cannot be denied that they stand high as citizens, yet they are often too occupied with their own problems to consider those of their profession as a whole or of the community in which they live.

Public Duty of Engineers

Engineers are not easily organized. If they had pulled together a little over a third of a century ago when a previous attempt was made to group the engineering activities of the Government, they would not have met defeat at that time.

Engineers are accused of being unresponsive. It is said that they are aloof and indifferent when it comes to matters of a public nature. These charges, it must be admitted, have often been justified in the past. It is the duty of all engineers to disprove them for the future.

The participation of engineers in the World War has called attention to the importance of their work. It was largely an engineer's war. The profession of engineering has never occupied so dignified a position in the world as at the present time. Shall we admit that we are incapable of so organizing that our petitions will receive a respectful hearing at Washington?

Let us remember that our cause is not a selfish one. We seek to abolish the waste of effort and of funds incident to work costing millions of dollars annually, to replace conditions that are disordered and scattered with others that are orderly and efficient. This accomplishment will benefit all the people and will be another step in the path of progress that eventually will prove the falseness of the assertion that republics can neither be efficient nor economical. Incidentally, the profession of engineering will receive some long delayed but merited recognition.

This is a matter of good citizenship—of broad practical patriotism. We expect experts to take the initiative in their special fields. The people of this country expect the engineers to lead the way in engineering matters. Here is a question that involves the public good and therefore the interests of every individual living in this wide country. To turn back is impossible. We must win and every engineer must be a missionary in spreading the gospel of the National Department of Public Works until the public shall know the truth and with us demand the necessary legislation—for the good of all.

SOME FEATURES OF THE HIGHWAY PROBLEM

By E. R. Conant, Consulting Engineer, Brunswick, Georgia.

When we stop to consider that there are several hundred thousand miles of roadways in the United States, and when at this date there are 7,000,000 motor vehicles; and, further, when improvements of road and bridge construction are proposed aggregating hundreds of millions, if not billions, of dollars in cost, we begin to realize what a stupendous problem lies before us in getting a highway system in shape to accommodate modern methods of transportation.

Engineers are called upon to make a scientific study to determine what types of construction should be followed considering initial cost, durability, deterioration, and still further what construction should be carried out for motor vehicle traffic so as to keep down as low as possible the maintenance and operation cost of motor cars.

Financing Highway Construction

Another most important feature of the problem is that of the method of financing construction. During the past year or two there has sprung up almost over night a demand for good roads. County units and states have fallen over each other to get road bond issues out. Unfortunately, highway engineering, which is a science, has not advanced far enough, and in connection with this, federal and many state highway organizations are not equal to the occasion, and are not in a position to cope with the problem. It must be admitted, however, that administrative heads and engineers have not had time to work out and formulate plans and design proper types of highways to meet many cases, and it is to be expected that mistakes will occur, but fortunately the people are being educated to the necessity of proceeding with caution, and to see the necessity for adequate, administrative organizations, federal as well as state. Those observing the start in the problem of highway construction see features that need attention. The issuance of low-term bonds for construction of highways with a type that under no condition can be expected to last one-half the life of the term of the bond, is entirely wrong and should be corrected.

A Market for All Good Pavement Types

Regarding types of construction, it is very apparent that with the great mileage of roadways to be constructed there need be no fear on the part of those interested in promoting any standard type of pavement that there will not be a call for that type to the limit of the ability to furnish material for it, but no one type is applicable for all sections, and promoters of various pavements should study out locations where their particular type is applicable. It should be borne in mind that certain types applicable for trunk lines through states where heavy motor traffic is anticipated will not be applicable for general county road construction on account of the cost. Therefore, unnecessarily heavy sections should not be required where underlying soil conditions and prospective traffic permits of lighter construction.

Use of Local Materials

Again, many mistakes are being made in not adopting types of roadways involving the use of materials that can be used most economically in the locality where construction is under way. It is wrong to consider the use of material where rail transportation and hauling is out of proportion to the cost of the material. In calling for proposals, it is wrong to submit specifications that are not on equal bases, or if they are not on equal bases, the relative value of the types should be fixed and stated before bids are received, so that contractors may be in a position to give proper weight to their expectations of being con-

sidered if their bid price is not the lowest. It is folly to think of using standard specifications for various states, and even in the same state requirements may and will vary at different localities.

Design Features

Too much stress, in many instances, is being laid on details regarding surveys, and too little as regards the feature of straightening out old highways and in considering the elimination of grade crossings. It is very well to call for the lay-out of the highway with railroad curves with all functions of such curves required, but to be consistent, more weight should be laid on the study of the character of the underlying soil. It is possible to work out quantities of cut and fill so as to bring about their equalization, but attention should be given to the character of the material which is moved, for in some instances it would be better to waste material excavated and go to an additional cost of getting suitable material for the sub-surfacing of the roadway.

Many specifications are too exacting as regards the use of certain materials. To take, for example, sand: many sections of the country do not have sand deposits where the requirement of it for tensile strength meets that with the use of Ottawa sand. Where the specifications require 100 per cent. tensile strength of the sands as compared with Ottawa, good judgment and economy would often result if a little variation were allowed as regards the tensile strength of the sand, by making an adjustment with additional cement to the mixture. Too much stress is often laid on the requirements for a rigid base, where, under certain conditions a flexible base could be obtained at lesser cost, and when local material would result in economy and equally as good a type of construction.

There is no question but that time will bring about a greater improvement as regards the method of construction of our system of highways, and the sooner the people are educated to see the necessity for the formation of strong state organizations, and with the expected large appropriations for federal aid, should encourage through their representatives the passing of a bill creating a federal highway commission through which a national systme of highways can be worked out and proper organizations formed successfully to formulate and carry out the projects.

FOUNDATIONS FOR WARRENITE—BITULITHIC PAVEMENTS AND ROADS

By George C. Warren, President Warren Brothers Co., 142 Berkeley St., Boston, Mass.

At the outset let us consider three general propositions:

1. Practical experience is the best guide. "The Proof of the Pudding is in the Eating."

2. One remedy for every disorder is unscientific and not good practice and savors of the "quack" in medicine. Similarly, an engineer who holds that one type of construction of either foundation or wearing surface is the most efficient and economic for all, or most conditions, has a "one track" impractical mind.

3. The essential requirements of a pavement foundation are:

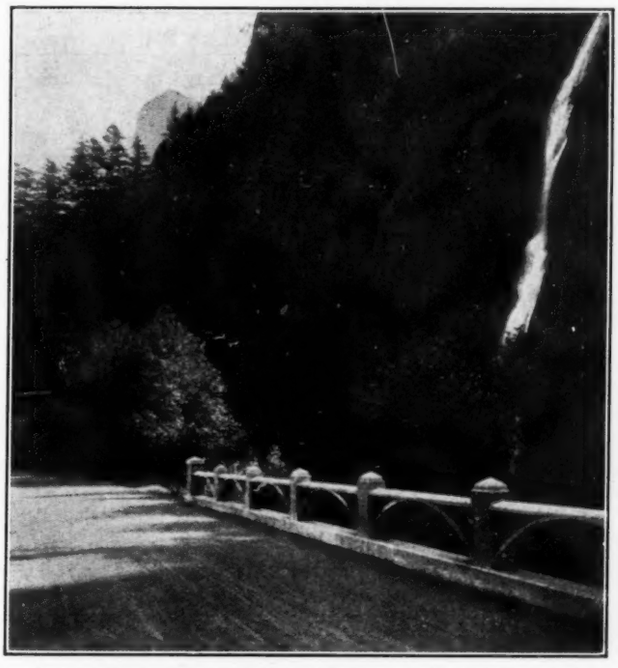
a. Resiliency.

b. Strength.

Between these two more or less compromise must be given, dependent upon the conditions of each particular road and here is where the broad evenly balanced mind of the engineer is essential.

As a third and only somewhat less important consideration the speaker includes:

c. As close union between the base and surface as is practical with due consideration to the other factors. It will be noted that we place strength of foundation second. This is not accidental. In fact the writer, after a large experience, believes that extreme strength of foundation,



WARRENITE-BITULITHIC PAVEMENT LAID OVER OLD MACADAM.

which necessarily includes rigidity, is actually detrimental under many if not most conditions of sub-soil and drainage.

Resiliency in Pavement Foundations

Resiliency, on the other hand, is an extremely important factor in consideration of the matter of wear and tear of the pavement or road surface. Where natural or proper economic artificial drainage is provided and the sub-soil is of a character which can be rolled to a reasonably solid condition, resiliency can be given first place in consideration of the foundation for stable, monolithic resilient pavement or road surface.

On the other hand, if a road or pavement sub-base is weak through poorly drained or weak sub-soil, strength of foundation with its attendant evil of rigidity becomes the most important and controlling factor for consideration. It is futile to say that because a certain type of foundation was a success or failure on road "A" that it will be the same success or failure on road "B," the conditions of which are very different.

The highest degree of tensile strength and its attendant rigidity necessarily carry with them the certainty of more or less cracking from contraction and heaving from expansion under climatic changes, because of the fact that there is no "give," short of a break. Serious cracks in a pavement foundation will cause corresponding cracks in

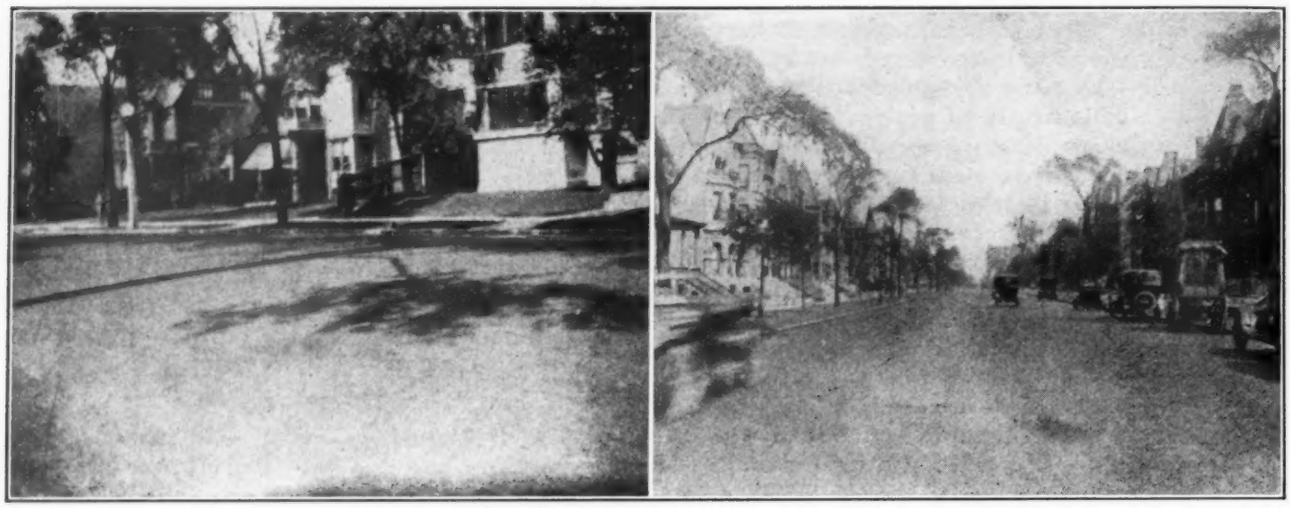
the wearing surface. In the writer's home city of Boston he has seen granite block pavement laid on a rigid Portland cement concrete base, and rigid filler actually cracked through the granite block under sudden temperature changes. The strength and rigidity of both base and surface clearly caused the cracks. The cracking is immediately followed by serious wearing of the edges of the cracks under normal traffic.

If we want to break a surface with the blow of a hammer we would place it on a rigid, solid stone or anvil, knowing that if we should place the substance on a sheet of rubber (which is the acme of resiliency) the blow would have no effect whatever. So in a pavement surface. If other conditions including drainage, sub-soil and character of wearing surface make the use of a resilient base practicable, then the wear and tear on the wearing surface under the blows of traffic are vastly less than if laid on a rigid base.

And yet we find strong agencies working a powerful propaganda intent on preventing the economic conservation of these millions of past expenditures.

Reference to a few specific instances under widely varying traffic and climatic conditions should suffice as follows:

Highland Avenue, Birmingham, Alabama,	Laid in 1904
Dartmouth Street, Boston, Mass	Laid in 1903
Commonwealth Avenue, Boston, Mass.,	Laid in 1915
Sheridan Road, Chicago, Ill.,	Laid in 1906
Michigan Ave., Chicago, Ill.,	Laid in 1907
Columbia River Highway, Oregon,	Laid in 1915



VIEWS OF WARRENITE-BITULITHIC PAVEMENT LAID OVER OLD MACADAM.
Left: Sheridan Road, Chicago. Right: Michigan Boulevard, Chicago.

Surfacing Old Macadam

With these general principles let us consider details.

Macadam roads, whether of crushed stone, gravel, slag or oyster shells, are resilient and still solid enough to hold weight of traffic as distinguished from the motion of traffic.

There are in existence today such macadam roads which have cost millions of dollars and which as a wearing surface would not sustain the traffic of modern motor vehicles, but which if not removed would provide an economic base either in whole or if worn too thin with proper surface addition of new metal. There are too many years and too varied practical experience behind us to permit controversy of this engineering proposition.

In the experience of the organization with which the writer is associated this has been successfully demonstrated by:

a. Fifteen years' successful results of use in more than one hundred municipalities and under all the widely varying climatic conditions of the United States and Canada.
b. Used to the extent of over eight million square yards.

Incidentally, periodic traffic records on Michigan Avenue, Chicago, will be of interest:

Date of Record	Motor Driven Vehicles	Horse Drawn Vehicles	Totals
Aug. 16, 1907	1,884	1,024	2,908
July 26, 1912	10,462	126	10,598
Sept. 2, 1919	20,179	25	20,204

Note in the twelve years the total traffic increased seven times while in the same period the horse drawn traffic had reduced from over thirty per cent. to only one-eighth of one per cent. This shows how rapidly the horse is becoming nearly obsolete as a means of pleasure traffic. As to truck traffic we are rapidly approaching the same condition which means new problems and elimination of a considerable number of the old problems of road construction as to both foundation and wearing surface.

In order to avoid disturbance of the old macadam, as far as possible, it is important to "humor" the grade and as closely as practicable, follow the old established grade merely knocking off the humps, using the material to fill the depressions. On country roads particularly, regardless of the type of old construction or new foundation or wearing surface the best practice is to merely level off and build on the old grade. Under general country road conditions no harm results from raising the grade a few inches and, generally speaking, the economic advantages are very great both in drainage and first cost, as well as subsequent maintenance by slightly raising the road surface above the surrounding country.

In conclusion of the subject of surfacing old macadam, it should be borne in mind that the integrity of the old

road-bed should be carefully proved by test holes or still better test trenches across the road at frequent intervals. If such test develops a depth of, say 6 ins. or more, of well compacted crushed stone, gravel, slag or oyster shells with the coarse aggregate predominating, it is safe to say that the foundation is adequate for such a stable, dense monolithic water-proof surface as we are discussing. If such tests show a deficiency of such old metal then there is still enough of any old material to make its conservation most economic for reinforcing by the surface addition of a more or less varying depth of new metal.

New Compressed Stone Base.

The principles embodying this construction differ only slightly from those which pertain in the case of old macadam base.

VIEWS OF WARRENITE-BITULITHIC PAVEMENT LAID ON OLD MACADAM FOUNDATION.
Left: Dartmouth Street, Boston, Mass. Right: Commonwealth Avenue, Boston, Mass.

First attention should be given to drainage, and second to compression of the sub-grade. With a well drained, well compacted sub-grade there need be no question of the sufficiency of a well laid compressed stone base, under most traffic and climatic conditions.

It is desirable that the lower portion of the base shall be of as large stone as the local conditions permit. If crushed stone is used it is desirable that the largest particles will be as large as 3 to 4 ins. in diameter. If economically available it is desirable to lay a lower course of quarry or field stone, preferably slabs, about 4 ins. thick, laid on the flat side. Often in country road construction through stony or mountainous country such as prevail in New England and the mountainous regions of the far West and many other sections, such slabs or other large pieces of stone are not only the best but the least expensive material for the bottom of the base. The large stone should, of course, be supplemented by the laying of a sufficient quantity of new smaller stone to provide the desired depth and contour and the whole compressed by heavy roller until a sound base which will not creep or compress under further rolling is provided.

Under the extremely heavy traffic of war conditions in France and Belgium, it was found that rather flat stone as a lower course and a total depth of 8 to 9 ins. of metal would sustain the weight of the immense motor truck and artillery traffic, but without an additional substantial wearing surface it would not long sustain the motion of traffic.

This construction of new compressed stone base and Warrenite-Bitulithic surface has been practically and sucessfully used to the extent of over 12,000,000 sq. yds. during the past 18 years, and over 3,000,000 sq. yds. are under construction and contract during the present year.

Some notable examples are:

1. The entire State of Oregon, including a large mileage now under contract with the State Highway Department and in nearly every city and county of the state, beginning with the City of Portland in the year 1903, since which date over 2,000,000 sq. yds. have been laid in the City of Portland alone. Of all this vast area of Warrenite-Bitulithic in the State of Oregon laid during the past 18 years, all is on what this paper discusses as "resilient" bases, to-wit:—either Old Macadam, New Compressed Stone or Dense Bituminous Concrete.

2. In Salt Lake City and elsewhere in the State of Utah, over 200,000 sq. yds. have been in practical, successful use in the city alone during the past 10 years, and over 30 miles of country road in the several counties during the past 3 years. In Utah, portions of compressed base are crushed stone and other portions are iron furnace slag. The celebrated Orange Grove Avenue, Pasadena, California, is laid on compressed stone base, has had no repairs and the contour is in perfect condition after nine years' use.

3. Within the past two weeks following about 7 years' practical, successful experience the City of Twin Falls, Idaho, has contracted for over 300,000 sq. yds. of Warrenite-Bitulithic laid on new compressed stone base.

Dense Bituminous Concrete Base

In connection with Warrenite-Bitulithic surfaces dense bituminous concrete base has been adopted during the past seven years to the extent of over 3,000,000 sq. yds. in over 50 municipalities and we can say without equivocation that, there is no type of foundation which as a whole has resulted in so nearly absolutely and uniformly successful results.

It will be noted that the Warrenite-Bitulithic surfaces unite to a high degree with old macadam and new com-

pressed stone bases, because the surface becomes compressed into the spaces between the upper portion of the base stones. In the case of dense bituminous concrete base the unity of the surface to the base is absolute, because both courses being of the same character under the heat of the surface mixture and the pressure of the roller becomes absolutely united so there is no line of cleavage and possible displacement.

The total depth of dense bituminous concrete base and Warrenite-Bithulithic surface ranges from 4 to 5 ins. The mineral aggregate of both courses may be either crushed stone or gravel. In the far West where bituminous materials are comparatively cheap and where clean, sound gravel is economically available, this construction has been generally laid at lower cost than is possible with an adequate depth of a rigid Portland cement concrete base. In the East under past low prices of the cement, Portland cement concrete base has had the advantage in the first cost and consequently very little bituminous concrete base has been laid in the East. Under present uniformly high cost of Portland cement, however, in many if not most places the dense bituminous concrete base construction is now generally as low if not lower than the Portland cement concrete base.

Portland, Oregon, has 500,000 sq. yds. and Pendleton, Oregon, having high altitude, and rigorous climatic conditions 150,000 sq. yds. of this surface construction, Warrenite-Bitulithic on dense bituminous concrete base where they have the practical test of seven years' successful use. California, Arizona, Idaho, Utah, Montana, Washington, Wyoming and British Columbia have large areas.

Following this successful use in all the far West states and provinces, the United States Army Department supplemented by the U. S. Bureau of Public Roads, adopted dense bituminous concrete base for the Warrenite-Bitulithic pavement on all of the principal roads of Camp Lewis, (near Tacoma) Washington, to the extent of approximately 150,000 sq. yds. We can say without fear of contradiction that no cantonment roads of any type whatever have proved as uniformly successful under the rigorous army cantonment traffic as the roads referred to in Camp Lewis, where local bank gravel was used as the mineral aggregate of both wearing surface and base.

The foregoing paper by Mr. Warren was presented at the 25th annual convention of the American Society for Municipal Improvements held at New Orleans, November 11-15, 1919.

THE AMERICAN HIGHWAY PROBLEM

Presidential Address of A. R. Hirst at Annual Convention of American Association of State Highway Officials at Louisville, Ky., Dec. 8, 1919.

The American people, almost as one man, are demanding, and that instantly, a modern and comprehensive system of highways and are willing to pay the price. They have at last realized that the price of building highways which will serve the needs of the present and of the logically to be expected traffic is far less than the price they must pay if the present embargo of mud continues. Never, I believe, since the days of early railroad development have the American people been so determined to change instantly their means of transport and not even then were they so willing to pay the cost, provided they could get the results.

People Demand Results

What are the results they are now demanding and what are some of the problems that grow from these demands?

They are expecting the states which had no highway organizations three or even two years ago, which had done no preliminary work and in some of which hardly a mile of modern rural highway had ever been built, to create an organization full sprung from the earth, and to build instantly hundreds of miles of modern roads costing millions upon millions of dollars. In the older states in the highway game, better prepared with organizations and contractors, and with some knowledge of material and construction conditions, they are asking us to double, triple or quadruple our annual output of roads. It is probably fair to estimate that the expenditure for modern highways in rural America in 1919 was about $200,000,000 and that the sum desired to be expended for them in 1920 exceeds $600,000,000. In other words, the people of America desire approximately to triple their highway expenditures and to do it in one year.

Highway Program Dwarfs the Railroad Record

We are wont to think of the era of railroad building in America as presenting the greatest of engineering problems and that its solution was an astounding exhibition of the capacity of American engineering genius. However, the problem confronting American highway engineeds today far exceeds the old one in magnitude. In the record five years of railroad development (1879 to 1883, inclusive) there were built 40,000 miles of railroad costing, as nearly as I can ascertain, about $20,000 a mile, on the average, or $800,000,000 in all. In the five years from 1920 to 1925, inclusive, the American highway engineer will be expected to build probably 100,000 miles of highway costing not less than $3,000,000,000. Even allowing for the depreciated dollar, the yardage of earth to be moved, the amount of materials to be furnished and transported, and the labor required is probably at least double that required in the former enterprise.

Some of Our Problems

It may be of interest to list some of the tremendous problems facing the executives of state highway departments in this work of speeding up the national highway program to meet the American demand.

Trained Engineering Help

1. The Problem of Trained Engineering Help to make the Surveys and Plans, the Preliminary Investigations and to Perform the Inspection.

This is a problem largely for American educators but with the present shortage and the very restricted output of young engineers, due to the war, it is an acute one demanding immediate attention. I might add that, in my opinion a four-year course is longer than is necessary for the preparation of much of the help that is needed, and a solution should be sought along the lines of the winter short courses of our agricultural colleges. We must have hundreds, yes thousands, of trained men at the earliest possible date and four or five years hence will not do.

Materials of Construction

2. The Problem of Materials of Construction.

Nothing is more certain than that there will be an acute shortage of materials in 1920 and thereafter, unless there is substituted in place of the present hit and miss methods an intensive study of all available road materials in every state and unless the most strenuous methods are used to develop every available source of supply. The expensive production and delivery of road materials during the winter season is going to be necessary, especially in the northern states with short construction seasons. Every state must establish a road materials department, the sole function of which will be to locate, test, develop and arrange for the proper delivery of all available materials. Already there are rumors of combinations of material men to purchase and control all sources of highway materials. It is up to the states to protect their people by getting sufficient material sources in state and county hands before it is too late.

Cement

3. The Problem of Cement.

It seems obvious that much, if not all of the so-called permanent surfacing will be either cement concrete or other surfacings on a cement concrete base, and that practically all drainage structures will be built of concrete. Unless there can be had the most absolute and fair federal control of the price of cement the bidding between municipalities and states and between contractors for cement is apt to drive the price up to the point of impossibility. In lack of federal control, the erection or purchase by the states of cement mills or state control of the output of certain mills would seem to be only a rudimentary conception of the duty of protecting the public against unduly inflated prices. The present unfair arrangement between manufacturers and dealers whereby dealers who never see or handle the cement must be paid hundreds of dollars for every mile of road built of concrete or with a concrete base must also be controlled effectively. States which buy millions of barrels of cement annually and pay always (no bad accounts) must get at least the dealer's price.

Car Service.

4. The Problem of Car Service.

Car service has been execrable on practically every railroad. We have been handicapped day after day and month after month by the criminal neglect of the present railroad officials to recognize the fact that highway building is a great American industry. If construction is to be carried on with materials delivered by rail, better car service, and in the northern states, a longer season for shipments is necessary. Possibly the time will soon return when freight revenues will mean something to American railroads and when it will not be an insult to a railroad man to offer his company freight business. I sincerely hope so. Until then we ought not depend on materials involving a railroad haul except where no other source of supply is humanly possible. If the railroads are allowed to come out of their present state of coma and will give us the proper type of cars, enough of them, and reasonable service at fair prices in the installation of unloading sidings conveniently near the work, their revenues can be very materially increased, our costs decreased, and our work speeded up.

Even in this railroad problem we must interest ourselves because we can never build our roads unless this American "sleeping beauty," our railroad system, is given an injection of dynamite and made to live again.

Efficient Construction Organizations

5. The Problem of Efficient Construction Organizations and Fair Prices.

The contracting problem we always have with us. We need every competent highway builder available and we need immediately to multiply his number two to five times in the various states. We must encourage those good contractors who are now available and develop many new ones. To do this good prices will have to be paid and fair treatment given. On the other hand, we must not hand over our clients' pocketbooks to the contractors with the injunction "take what you think is right, but please return us the cover." Unless some restraint is exercised, with the amount of work there is to be done and with the universal feeling existing that "my road must be built no matter what it costs" prices will be driven up and up without regard to proper cost, values or profits.

In this connection it is my belief that each state should immediately develop a moderately large construction organization fully equipped to do a portion of all classes of its work. Then in case prices on certain work are extortionate, the work may be done by force account. This plan has the advantage of developing and training the nucleus of a larger day labor organization if one should later prove necessary. It also gives at all times a true index of the cost of various kinds of work on the basis of actual and recent state experience. We cannot know the actual cost of work unless we are actually in the construction game.

Every state has availed itself, I believe, of the offer of war equipment from the federal government. Large supplies of many things useful in highway work, especially motor trucks, have been or will be received. The organization of a proper department to receive, fit for use, and handle this equipment is no mean problem. The states should carefully consider whether this equipment should not be made the basis of building up a permanent thoroughly well equipped day labor organization as a means of protecting itself now and in the years to come.

I also believe it necessary for adjoining states to co-operate with a view of keeping prices for work fair and uniform under the same conditions. If adjoining states are going to bid against each other the cost of work in all of them will be sent up to the prohibitive point without any ultimate advantage to any state. It should be possible for the states to get together on this matter. Costs are quite figurable for each job and with a uniform system of allowances for the use of machinery, profits and contingencies it should be possible to put work in all states on an approximately equal basis of attractiveness. These allowances must be generous, because we must attract the best contractors, but they need not, and should not, be wasteful. This problem is the most acute of all our problems and should be given immediate and serious attention by every state. I can think of no way in which more millions can be unnecessarily spent in the next few years than by allowing unbridled and useless competition for contractors and materials to prevail between municipalities.

Labor

6. The Problem of Labor.

We speak blithely of millions of dollars for the construction of thousands of miles of road. This program means men, far more men than have ever been employed in this work before. But men are scarce and other productive labor must not be raided. Our farms, our mines, our factories, and our mills must be allowed to produce largely and at a reasonable cost. We should not pay our labor, or allow such prices to contractors as will enable them to pay their labor, a sum per day greatly in excess of the going wage for like work in that vicinity. Whether we pay high prices for labor or whether the contractor does, it is our responsibility, because the prices we pay for work determines the prices which can be paid for labor. In other words, we must not bull the labor market to the disadvantage of other production. This is public work, its continuance depends upon the support of the whole public, and we must be careful not to alienate this support by forcing our work at undue prices, thus upsetting local labor situations. This policy is not only right from the standpoint of expediency, but is also economically sound.

Improved Location and Alignment

7. The Problem of Improved Location and Alignment. We have, in the past been too prone to build along the old established lines of highways. This has been the easy course and it has been taken. But the new traffic conditions are so different and so intense that in considering the construction of a main trunk highway all of the old governing considerations, such as saving the buying of new lands for right of way, utilizing old cuts and fills, saving an existing bridge or a few good culverts no longer bind us to the old locations. We must connect the centers of population because they are the points from which things and persons come and to which they wish to go. In building a modern highway between these fixed points we can feel free to exercise our untrammelled judgment and build where the road will ultimately cost the public the least. Shortness of distance, freedom from dangerous curves and from railroad grade crossings, and reasonable grades are now the principal ends to be sought and practically nothing else counts.

Cost of construction has become secondary. If the very conservative sum of 10c per mile is allowed for each mile of travel saved, the saving of a mile in distance on highways carrying the following average number of vehicles per day will save the traveling public the given amount per year, which is the interest at 5 per cent. on the amount given in the third column.

VALUE OF A MILE IN HIGHWAY DISTANCE SAVED

Average Number of Vehicles per day	Saving to Owners Per Year	Saving Capitalized at 5% Equals
100	$3,650	$73,000
250	9,125	182,500
500	18,250	365,000
750	27,375	547,500
1,000	36,500	730,000
2,000	73,000	1,460,000
5,000	182,500	3,650,000
10,000	365,000	7,300,000

I believe that these figures are unassailable and that they demonstrate that when building our main highways for all the years to come, saving in distance in the layouts is the supreme consideration and should be given much more attention.

Other Important Problems

Many other important problems could be named and briefly commented on but this paper will be too long if continued along these lines. I cannot, however, resist naming without comment some of the other things with which an efficient state highway department must also concern itself.

8. A Proper System of Records of the Cost of All Construction and of Acounting for all Funds Available.

9. Proper Publicity of Plans and Results, Not Only in the Local Press, but in the National Press.

10. Proper Care of Traffic During Reconstruction.

11. Proper Touring Maps for the information of the People of the State and of Other States.

12. Proper Marking of the Main Traveled Roads, Keyed to the State Maps.

13. Proper Accommodations for the Traveling Public in the Way of Garages, Hotels, Public Parking Places and Comfort Stations.

14. Complete Knowledge and Study of, and, if Necessary, the Design of Labor and Time Saving Devices and Equipment.

15. A Study of Plant Layouts and Equipment for Various Types of Construction Under Varying Conditions.

16. A Study of the Grade Crossing Situation and a Strong Campaign for Improved Conditions.

17. The Holding of Road Schools and Short Courses for the Instruction and Inspiration of all Classes Engaged in Supervising and Constructing Highways.

18. Helping to Formulate and Pass Adequate Highway Legislation so that the State May Keep Pace with other States.

The Coming Battle

It may readily be seen from this hasty survey of some of the attendant problems that these changed highway conditions and this spirit of getting hitherto unheard of results have, instead of making our task easier, but served tremendously to increase our problems and responsibilities. We are on the threshold of a new epoch in highway construction in America, but instead of congratulating ourselves today that the long fight for highways is won, we should rather gird our loins for the impending battle. Added responsibilities bring added fears to the executive who thinks and spur him on to new efforts and new devices for developing himself and his organization to meet the new conditions.

The coming battle is all the more serious because from time immemorial the American people, while always willing to pay the price for the work they desire, have never been willing to pay the price of the proper supervision of it. "Millions for public works, but a pittance for those who must design and supervise the building of them" seems to be the American spirit. Our national and state legislative halls are filled with men who appropriate millions and tens of millions with very little thought of the organizations necessary to expend them properly, and with much less desire to provide proper supervision than to further the prestige of themselves or of their political party.

Federal Policy

As a case in point. It was with the greatest difficulty that the present Congress could be induced to fix the

salary of the very competent present head of the Federal Bureau of Roads $6,000 a year, although this bureau will in the years 1919 to 1922, inclusive, supervise from the federal standpoint and protect the federal interest in the expenditure of probably two hundred millions of federal money and with it the expenditure of three hundred millions more from the states and local units. When a Federal Highway Commission is proposed to be created to expend billions in the layout, construction and maintenance of the proposed Federal Highway System, the salaries of the commissioners and of the chief engineers are fixed, under protest, at $10,000 each per year, and we are told that Congress will never stand for these salaries and that they will probably be cut to much less before the bill becomes a law, if it should become a law. The National Congress is probably the most niggardly employer in America, unless some of the states bear off the unenviable palm. It seems hopeless to expect a continuously efficient organization in any federal bureau unless Congress shall see a new light and fix public salaries to fit the imposed responsiblities.

It is interesting, although disconcerting, to note the almost total lack of interest on the part of road promoting organizations in the fundamental problem of getting proper administrative bodies to control the highway programs. We have good roads associations, trail associations, highway councils, etc., ad infinitum, all seeking to promote the construction of roads in detail or in mass, and urging the nation, the states and the counties to spend millions or billions on highways of all kinds, classes, sorts and conditions.

The sole idea seems to be to get money and more money to build highways. It does not appear to matter to them what kind of highways, who builds them, or whether the people get a dollar's worth or a dime's worth for a dollar. Men are in these associations who make millions every year, who control organizations which are solely designed to get efficient dollar for dollar results, and who pay their executives what they are worth. Yet when they get into the field of public service they seemingly forget all the rules which made their own business a success, and expect a thousand dollar man to be the eighth wonder of the world, and world-beating organizations to grow overnight with no possible financial encouragement. Unless business men of this class wake up and devote more thought to the basic problem of getting efficient organizations to spend the money, I fear a real disaster to our highway programs.

Politics and Salaries

All of us have probably in the past derided the possibility of getting effective results out of town and county highway efforts because (we said) politics had too great a part in road work in those units and that they would never pay the salaries necessary to get competent planning and supervision of the work. And yet in 34 of the 48 states which now have state highway departments, the Governor may change the personnel of the state highway department so as to control it during his term of office. In many of these states the highway law is deliberately so framed that a new Governor may make a clean sweep of the state highway department the minute he assumes office, if he so desires. In most cases he seems to have desired it. There have been at least 127 different executive highway officials in these 34 politically organized state highway departments in the grand total of 296 years of their existence, or a change every 2 1/3 years (on the average) in each state. The oldest executive officer in charge of highway work in any American state has served his state nine years in that capacity.

A state highway department is not right or it is not wrong just because it has a Republican or a Democrat at its head, or because one brand of Republican or Democrat is in control when another brand of the same political party comes into power. A state highway department is right when it is well organized to get efficient and economical results and is wrong when it is organized or unorganized to produce inefficient and uneconomical results.

Let us consider the salaries paid the executive officers of the state highway department. There is one who is paid $20,000 per annum; two $10,000; one, $8,000; two, $7,000; two, $6,000, and eight, $5,000; while 32 of them are paid less than $5,000, and 20 of them receive $3,600 or less. In this connection it should be remembered that the highway work expected to be supervised by a state highway department is now in few cases less than three million dollars a year and in many states it has reached, or will soon reach, as much as fifteen, twenty or twenty-five millions. What business organization in the world would pay on a similar scale for similar responsibilities or would expect to receive adequate results under such conditions?

I speak of these matters not in a spirit of fault finding, but in order to interest you in the great problem of building up public opinion to the point where, for its own protection, it will insist upon the proper organization of every agency which deals with the expenditure of these great aggregations of highway funds.

Clean Cut Efficiency

We must, by every means in our power, by precept and example, preach the doctrine of clean cut business efficiency in American highway administration. In doing so we will go up against the age-long prejudice of the American people against paying their public servants a living or a proper wage. From top to bottom the scale of public salaries is wrong. The constitutional and other officers of the nation, of the states, of the counties, and of all other municipalities are, practically without exception, being paid, not on a basis of what their services are or should be worth, but on a basis fixed (in most cases long years ago) with due regard to the "honor" which must accrue to the holder of a public office. The universal custom was, is, and possibly always will be, to figure that the prospective holder of the job will be a politician with other interests or means and that the salary won't matter, or that joy at getting the "plum" of public office will dwarf all material considerations.

There is or should be an honor in being selected for public service—and worthy public servants appreciate and feel that honor. It may be, although I doubt it, worth while for the American people consistently to penalize those who work for them by paying them less than a living wage or less than the work would command if done for a corporation, or if done for the individual citizen in his private capacity. But the trouble with the system is that when the American people have before them a piece

of really constructive work, like their present highway program, the policy falls down absolutely.

We must help the American people by making them realize that with hundreds of millions, even billions, to be expended in the next few years the building of highways is a profession and a business and not a political football to be kicked around like the proverbial pup. This is not selfishness. Most of us are in this highway business because we love the work and because we want to help build up the states and the nation. I doubt if there is one man here who has made good or who is capable of making good who cannot leave his present state position and make more money working for himself or in employment in commercial lines. But the work must go on and it must go on well and we must feel an interest above a mere financial interest in the jobs we hold, if we are worthy of them.

Money is not all—the satisfaction of creating, of building; of creating and building well; of helping to build a county, a state, or a nation, is worth more than a few hundred or a few thousand dollars a year if one can manage to live. We can't afford to pinch pennies and bandy words just for ourselves, but in the interest of the compentent and "up and coming" highway organization which must be created in every state to protect the interests of the people of the state, we can afford to fight for the right.

Unless there occurs a radical change in the American spirit of expecting much from their public servants and giving little, not one of us here will ever get rich or even attain a competence in the public service. We will, on the contrary, fight on and on until disgruntled politicians finally get us, or a younger and better qualified man supplants us. With the best of our youth, our enthusiasm and our strength gone, we will retire full of wounds, without money and without honors to make a new start in middle age. Such is the almost inevitable fate of the servants of the American people. But we can retire with honor unsullied and with our flags still flying. Later those who now fight the good fight for right standards and thus help make the path of their successors easy, may be recognized as public benefactors. When these pioneers are dead and buried, as is the custom here, they will be acclaimed as, after all, worth while and possibly even monuments will be erected to some of them.

I trust that nothing I have said in regard to state highway organizations will be wrongly construed. The present organizations, with very few exceptions, are and have been, doing effective work with limited opportunities. Where there is trouble it is in most cases due principally to the damnable political obsession of our American Commonwealths. In too many states it is not even debated that the old political motto, "to the victor belongs the spoils," is the law and the gospel, and the idea that the victory of any political party or of a faction of any political party should not carry with it the transfer of all offices with the Governor's control is not even considered, but a total overturn is taken as a matter of course. County and state officials without number have been thrown out of office for no other reason than that "they have held the job long enough, someone else should be given a chance." If a bank or a railroad, or any other corporation adopted the idea that political belief was the hall mark of efficiency or that long continued service was a valid reason for discharging their personnel, public confidence would be lost, their stocks would be a drug on the market and the corporation itself would become bankrupt.

In fairness to my home state, Wisconsin, it should be stated that we have a non-political highway commission, the operations of which have been entirely free from political interference by the Governor or anyone else. I state this because there may be some idea that my remarks originate from dissatisfaction with conditions in my own state, which is not the case. Conditions, laws and public sentiment there are good and improving fast. I have, however, long been a student of American highway administration, have followed changing state laws and personnels, and have attended practically all national highway meetings for years. As a result of these observations I believe I can safely say that the great American highway problem will never be solved rightly until we get our state and county organizations safely established on the sole basis of well paid efficiency.

The American public must be convinced that if they will play politics with their public officials they should confine themselves to routine offices where almost anybody can get by because someone else does the work anyway. They must be convinced, on the other hand, that the highway departments of the states and of the counties come into a different class and that here merit and knowledge should be the sole criterion in selecting and keeping their officials, and that here at least, length of training and service is of tremendous value and a necessity if efficient and economical results are to be secured.

The professions of highway engineering and of highway building must be dignified so that they attract the best engineers and the best construction men in America. This is important, not only for the immediate future, but especially so for the years to come. Not only must we strive to attract and keep the best we have, but we must get the coming men. We need all the brains and all the talent we can muster. To attract the best young men, good working conditions, a clean atmosphere in public service, adequate compensation and a reasonable chance of advancement must be offered. Less than this will not serve.

Therefore, let us dedicate ourselves to this work of helping to make all highway organizations efficient instruments, able and competent to carry out the American purpose of building a highway system befitting the greatness of the American nation. Than this, we can do the American people no greater service.

SUGGESTED ECONOMIES IN BRICK STREET AND ROAD CONSTRUCTION

By Will P. Blair, Vice-President National Paving Brick Manufacturers' Association, Cleveland, Ohio

The economies of highway improvement embrace distinctive divisions of sufficient importance to be treated separately. There is that economy which bears a relation to the use of the road; there is that economy which pertains to the adaptation of the kind of road to the uses of traffic it is expected to bear. But fundamental to all road

economies is that economy which is possible in the construction of every kind of road. What is necessary to include and what should be excluded is of paramount interest at this time.

Standard Paving Brick

In the construction of brick roads, we have not yet developed the use of tools and appliances to that extent which we should, which will lessen the actual labor necessary in brick street construction. However, this factor of construction economy is receiving attention and much progress has been made recently. The manufacturers of vitrified brick have had the courage to adopt a standard size paving brick, the dimensions of which are 3x4x8½ ins. This is a distinct step in economy, both in the matter of increased production and convenience in use.

Sub-Soil Conditions

It is true that we have made progress out of the visualization which we are able to exercise through the long experience in the use of a great variety of types of brick pavement construction. We can almost unerringly draw out of this experience and observation many points of economy even in the absence of knowledge of underneath soil conditions and the resulting behavior of the same, physical and climatic. Being obliged to accept these conditions, we can provide against some known behaviors. We do know that soils saturated with water under the influence of low temperature, create an expansion almost irresistible in the force of its strength. This force irregularly exerted from underneath breaks and cracks the superstructure, if brittle in character, almost regardless of the strength of the superstructure.

We know that in the absence of such saturization pavements are not subject to such destructive force. Thus we see some brick pavements injured by this cracking process. We do not find the individual units of the brick pavement injured to any extent. On the other hand, there are hundreds of miles of brick pavements resting upon soils so thoroughly, naturally or artificially, drained that no apparent injury is exerted. The brick in such pavements held in alignment, do not show any perceptible wear. The life, therefore, of such pavements is unknown. They would last indefinitely.

Broken Stone Base and Bituminous Filler

Extremely moist soils often, when not frozen, furnish such unstable support that shock-effect in the nature of crystallization finally exerts injury. Out of a study of these influences has grown a belief that a rolled broken stone base will so perform a drainage function as to stabilize soil support and at the same time afford sufficient voids that frozen moisture content will cause but little expansive force, so that a broken stone base is a great assurance against injury from frost action.

An added assurance against injury is the employment of a bituminous filler which possesses qualities of adhesion and cohesion sufficient to hold the brick in place and yet afford a yielding quality which results in an adjustment and re-adjustment following any expansive force.

Therefore, a combination of the two, a rolled broken stone base with a Bituminous filler, unites against injurious effects in a most wonderful way. These qualities, thoroughly understood, combine an element of economy so great that it may be regarded as real progress in economy of brick road construction.

But the purpose of this paper is to call particular attention to some things which we have hitherto failed to do in the construction of brick streets and roads and other things which we have allowed to be done or carelessly submitted to, which really amount to encouragement or actual approval and against which we have been unwilling to protest.

Curbs on Country Roads

Curbs are required along the sides of the edges of city streets as a part of the gutter provision for the flow of water and as a wall to support the lawn or sidewalks at grade elevation. They form a part of the finish which contributes to the tasty appearance of the street. But how often do we come in contact with that influence which has grown out of conditions of years gone by, when great gutters were dug along the streets upon the theory that the surface of the street itself could be more readily drained thereby. Hence we have deep expensive curbing and unnecessary high crowns to streets for which there is no earthly reason. The crown of the street and the height of the curb should never be more than necessary for the proper surface drainage.

In highway improvement along routes not paralleled by sidewalks experience has shown that where monolithic or semi-monolithic construction is used by laying the brick in green mortar or mixture of sand and cement and filling the joints with a cement filler, curbs are not needed.

Experience has also demonstrated that curbs are not needed where asphalt fillers are used. The practice of making the curb an integral part of the foundation is more harmful than beneficial. A trough is formed which holds the water, permitting it to subside into every chance crevice and opening in or underneath the pavement instead of the needful provision for an unimpeded flow from off and away from the pavement.

Experience has further shown that a curb independent of the base and set up against the pavement performs its supposed function with but little effect. The frost raises the curb out of place or, with a moistened condition outside the curb, it is easily pushed away, leaving the base without any embankment support whatever.

A gravel, broken stone or slag embankment or shoulder which would be subject to compaction by the occasional over-lapping of vehicular wheels has proven a far better protection. A still better protection is a berm penetrated with a bituminous material which will allow readjustment of a possible displacement.

The curb for brick paved country roads is therefore largely a useless and costly appendage, incurring an expenditure of from three to five thousand dollars per mile that represents a waste pure and simple.

It has never been contended by any one that a curb built flush with the pavement was to bear any part of the traffic. In fact it never does. Then why not put the expense of the curb into additional width of wearing surface—to satisfy the growing demand for a wider roadway?

There are conditions upon hillsides and through heavy cuts where a curb becomes a necessity either for water disposal or for protection against water. But such are but mere exceptions to an almost universal rule.

In the matter of specifications for road improvement our largest efforts have been in the direction of perfecting, by description and nomenclature, the materials out of which the artificial superstructure of pavements is to be made. We have diligently searched and provided for, as to what constitutes and how quality may be ascertained, both with reference to the units of material as well as by specific and understandable directions, as to how these materials may be brought together in placement to the best advantage.

Lack of Knowledge of Soils

The economic value of all of this, however, is dependent entirely on the agencies which injure and destroy this artificial superstructure and the units of composition. These agencies are recognized as arising from two sources. That of traffic on the one hand and on the other the behavior from natural causes of the underneath soil condition. The destruction from traffic because of its visibility, has drawn from us our greater attention and study. But soil conditions, which exert a far greater influence on the durability of pavements than traffic itself, we do not understand. At the moment no engineer is able by any description, by any nomenclature, or by any classification of various characters of soils, to correlate them to such scientific treatment as will render injury on account of possible conditions, proof against injury to the pavement itself. We are so uncertain of our ability to characterize soil quality in relation to its ability to resist or influence moisture content by capillary attraction, that we merely visualize and we do sometimes say, drain here and drain there, as a kind of excuse or camouflage of our own ignorance, and in practice we install a pavement of exactly the same design, 5, 10, 15 or 20 miles in length, regardless of the condition upon which we place this track for traffic.

We are unable to direct how the sandy clay muck sections of our road or street sections shall be dealt with. Who knows in truth and in fact, just what you and I mean by the unintelligible terms of clay plastic or muck soils? Why not be satisfied by saying stiff asphalt, shale brick or rock cement? If we do not say so in so many words we act as far as we do act, under the undefinable and uncertain term of "sufficient drainage." The absurd and unscientific way in which we have dealt with the underneath soil conditions in highway improvement, or our failure to deal at all with it, should bring us to realize that as highway engineers we have yet some work to do. To place reliance of sufficient support of traffic upon certain artificial slab strength of costly structure, without knowledge of what is already in existence, and regardless of its worth for that purpose or without knowing with what small relative expenditure certain treatment may render its condition inadequate is but an acknowledgment of inability to economize and prevent great waste. Where, how and to what extent our drains shall be placed in each kind of soil to maintain in greatest stability we do not know, and if we should know, we have no means of intelligent nomenclature to convey that to others to interpret our meaning.

When we can classify or rate soils by some simple and inexpensive means of ascertaining its ability or limitation of capillary properties, and name the classification, and then correlate that soil to necessary treatment to maintain its stabilization and also to say what that treatment should be, we can then say whether our drains shall be 8 ft. apart or 20 ft. apart. Whether they shall be 3 or 8 ins. in diameter, whether they shall be 3 ft. or 4 ft. under the ground.

The writer realizes the magnitude of the task required to gain the information necessary to put into practical effect a workable specification which shall effect a cure for the conditions complained of.

However, the research work is under way, to be pursued with persistence until met with success or failure. It can not well be an exclusive effort. Suggestions will certainly be welcomed.

Acknowledgment

The foregoing paper by Mr. Blair was presented at the annual convention of the American Society for Municipal Improvements.

DOES IT PAY TO DETERMINE VOID PERCENTAGES IN COARSE AGGREGATE FOR CONCRETE PAVEMENT?

By William G. Crandall, C. E., Assistant Engineer, New York State Highway Department, 282 Central Ave., Cohoes, N. Y.

In the New York State Highway Department, it has been and is the custom in preliminary estimating of concrete pavement for a mix of 1:1½:3 to figure 1.9 bbls. cement, 0.84 cu. yd. stone, and 0.42 cu. yd. sand as the factors to use in obtaining the cubic yard price of concrete. Inasmuch as the percentage of voids in the aggregates determines the value of the factors, and a variation in the factors means a difference in the cubic yard cost of concrete, it would seem that a field investigation of the voids in the aggregates would warrant itself, to determine whether or not a contractor would increase or decrease his bids on the engineer's estimate of the concrete pavement by varying the factors, all other items in the analysis being considered equal for the purpose of comparison. Before working out a comparative analysis to show in dollars and cents what this difference means, it is necessary to explain the accompanying tables and curves.

Tables and Curves

The tables show the quantities in 1 cu. yd. of concrete based on 3.8 cu. ft. cement per barrel for proportions of 1:2:4 and 1:1½:3, the two mixes used by the New York State Highway Department in concrete pavement construction.

The purpose of these tables is to show at a glance what proportions of coarse and fine aggregate to use for either of the above mixes, based on the void percentages in the coarse aggregates. In the tables, the sand voids range from 25% to 45% and the stone voids from 30% to 50% by increments of 5% and the accompanying curves are used to obtain interpolated values of factors when the voids in either of the coarse aggregates vary from a multiple of 5%. The tables and curves show also the cubic yard and percentage excess of cement in sand and mortar in concrete.

TABLE I—QUANTITIES IN ONE CUBIC YARD OF (1:2:4 Mix) CONCRETE BASED ON 3.8 CU. FT. CEMENT PER BBL.

Voids		Cement		Sand	Stone	Surplus Cement in sand		Mortar in stone	
Sand	Stone	Bbls.	C. Y.	C. Y.	C. Y.	C. Y.	% comp. to sand	C. Y.	% comp. to stone
25	30	1.34	.189	.377	.755	.095	25.2	.245	32.5
30	30	1.36	.192	.385	.768	.077	20.0	.231	30.0
35	30	1.39	.196	.392	.784	.059	15.1	.216	27.6
40	30	1.42	.200	.400	.800	.040	10.0	.200	25.0
45	30	1.45	.204	.408	.816	.020	04.9	.184	22.5
25	35	1.39	.196	.392	.784	.098	25.0	.216	27.6
30	35	1.42	.200	.400	.800	.080	20.0	.200	25.0
35	35	1.45	.204	.408	.816	.061	15.0	.184	32.5
40	35	1.48	.208	.417	.833	.041	9.8	.167	20.0
45	35	1.51	.213	.426	.851	.021	04.9	.149	17.5
25	40	1.45	.204	.408	.816	.102	25.0	.184	22.5
30	40	1.48	.208	.417	.833	.083	19.9	.167	20.0
35	40	1.51	.213	.426	.851	.064	15.0	.149	17.5
40	40	1.54	.217	.435	.870	.043	9.9	.130	14.9
45	40	1.58	.222	.444	.889	.022	5.0	.111	12.5
25	45	1.51	.213	.426	.851	.106	24.9	.149	17.5
30	45	1.54	.217	.435	.870	.087	20.0	.130	14.9
35	45	1.58	.222	.444	.889	.067	15.1	.111	12.5
40	45	1.61	.227	.455	.909	.045	9.9	.091	10.0
45	45	1.66	.233	.465	.930	.024	5.2	.070	7.5
25	50	1.58	.222	.444	.889	.111	25.0	.111	12.5
30	50	1.61	.227	.455	.909	.091	20.0	.091	10.0
35	50	1.66	.233	.465	.930	.070	15.1	.070	7.5
40	50	1.69	.238	.476	.952	.048	10.1	.048	5.0
45	50	1.73	.244	.488	.976	.024	4.9	.024	2.5

TABLE II—QUANTITIES IN ONE CUBIC YARD OF (1:1½:3 Mix) CONCRETE BASED ON 3.8 CU. FT. CEMENT PER BBL.

% Voids		Cement		Sand	Stone	Surplus Cement in sand		Mortar in stone	
Sand	Stone	Bbls.	C. Y.	C. Y.	C. Y.	C. Y.	% comp. to sand	C. Y.	% comp. to stone
25	30	1.68	.237	.355	.710	.148	41.7	.290	40.8
30	30	1.71	.241	.361	.723	.133	36.8	.277	38.3
35	30	1.74	.245	.368	.736	.116	31.5	.264	35.9
40	30	1.78	.250	.375	.750	.100	26.7	.250	33.3
45	30	1.81	.255	.382	.764	.083	21.7	.236	30.9
25	35	1.74	.245	.368	.736	.153	41.6	.264	35.9
30	35	1.78	.250	.375	.750	.137	36.5	.250	33.3
35	35	1.81	.255	.382	.764	.121	31.7	.236	30.9
40	35	1.85	.260	.390	.779	.104	26.7	.221	28.4
45	35	1.88	.265	.397	.795	.086	21.7	.205	23.8
25	40	1.81	.255	.382	.764	.159	41.6	.236	30.9
30	40	1.85	.260	.390	.779	.143	36.7	.221	28.4
35	40	1.88	.265	.397	.795	.126	31.7	.205	25.8
40	40	1.92	.270	.405	.811	.108	26.7	.189	23.3
45	40	1.96	.276	.414	.828	.090	21.7	.172	20.8
25	45	1.88	.265	.397	.795	.166	41.8	.205	25.8
30	45	1.92	.270	.405	.811	.149	36.8	.189	23.3
35	45	1.96	.276	.414	.828	.131	31.6	.172	20.8
40	45	2.00	.282	.423	.845	.113	26.7	.155	18.3
45	45	2.05	.288	.432	.863	.094	21.8	.137	15.9
25	50	1.96	.276	.414	.828	.172	41.5	.172	20.8
30	50	2.00	.282	.423	.845	.155	36.6	.155	18.3
35	50	2.05	.288	.432	.863	.137	31.7	.137	15.9
40	50	2.09	.294	.441	.882	.118	26.8	.118	13.4
45	50	2.14	.301	.451	.902	.098	21.7	.098	10.9

Method of Figuring Quantities.

Following is the method of figuring quantities in one cubic yard of (1:2:4 mix) concrete based on 3.8 cu. ft. cement per barrel.

Take for instance a 40% sand and a 45% stone

Mix 1		Void %		Void	Swell
2	×	0.40	=	0.8	0.2
4	×	0.45	=	1.8	0.2

Stone Factor=4÷(4+0.2+0.2)=0.909 cu. yd.

Sand Factor=½×0.909=0.455 cu. yd.

Cement Factor=¼×0.909=0.227 cu.yd.

Cement Factor=(0.227×27)÷3.8 cu. ft.=1.61 bbls.

Method of Figuring Surplus

Cement 0.227 cu. yd.
0.182 Voids in sand (0.455×40%).

0.045 Cement swell.
0.455 cu. yd. sand.

0.500 mortar.
0.409 Voids in stone (0.909×45%).

0.091 motar swell.
0.909 cu.yds. stone.

1,000 cu. yds.(check).

As stated above, the usual practice in the New York State Highway Department is to use in figuring a 1:1½:3 mix for concrete pavement, 1.9 bbls. cement, 0.84 cu. yd. stone and 0.42 cu. yds. sand. While this may be good practice in preliminary estimating to disregard void percentages entirely, still, the same practice may be followed in the field.

In testing voids in stone and sand, especially the latter, there may be a variation of as much as 25%, depending on the physical condition of the aggregate.

Time to Take Void Percentages

Different void percentages may be obtained from sand in the bank and loose in piles, dry sand, sand containing different degrees of moisture, dry sand shaken or tamped, and sand being treated with water after the sand, cement and stone is mixed together. Therefore, especial precaution should be taken by the engineer on the road to take void percentages at the time directly previous to the actual mixing of the ingredients and in the physical state that the coarse aggregates exist directly previous to their incorporation to form the concrete. These void percentages should be taken every day and also when the character of the aggregate would tend to show a variation, as when a coarse pocket of sand would be evident in a bank from which a fine grade was being taken.

After these void percentages of sand and stone are derived the factors entering into the mixture may be obtained at a glance from the curve.

Example of Value of Void Determination

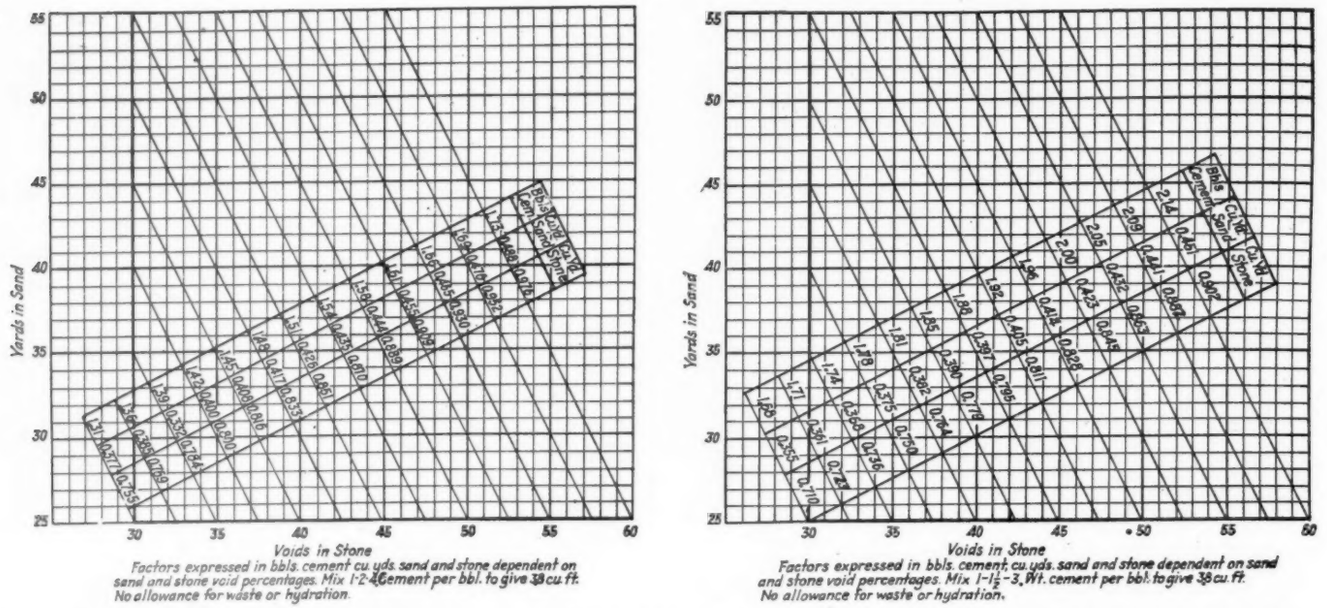
Assume the following analysis of cement concrete pavement:

Cement.		Stone.		Sand.	
F. O. B...	$2.35	Bin	$2.25	Royalty	$1.25
Handling .	.08	Haul, 1 mi.	.45	Wash, screen,	
Haul, 1 mi.	.08			Haul, 1 mi...	.45
			$2.70		
	$2.51				$1.70

For 1:½:3 mix use 1.9 bbls. cement, 0.84 cu. yd. stone and 0.42 cu. yd. sand.

Cement $2.51 at 1.9	$ 4.77
Stone $2.70 at 0.84	2.27
Sand $1.70 at 0.42	.71
Manipulation	2.50
Water and joints	.30
	$10.55
Profit, 20%	2.11
Waste and overhead, 10%	1.06
	$13.72
	Say $13.75

Suppose a contractor made a void test of the coarse aggregates in the field under approximately the physical conditions the stone and sand would be, when mixed, and determined a sand void of 35% and a stone void of 40%. From the curve the factors entering into the computation would be cement, 1.88 bbls.; sand, 0.397 cu. yd.; Stone, .795 cu. yd.


Yards in Sand
Voids in Stone
Factors expressed in bbls. cement cu. yds. sand and stone dependent on sand and stone void percentages. Mix 1-2-4 Cement per bbl. to give 3.8 cu. ft.
No allowance for waste or hydration.
Yards in Sand
Voids in Stone
Factors expressed in bbls. cement, cu. yds. sand and stone dependent on sand and stone void percentages. Mix 1-1½-3, Wt. cement per bbl. to give 3.8 cu. ft.
No allowance for waste or hydration.

DIAGRAMS FOR OBTAINING INTERPOLATED VALUES OF FACTORS WHEN THE VOIDS IN EITHER OF THE COARSE AGGREGATES VARY FROM A MULTIPLE OF 5 PER CENT.

Applying these factors to the above prices we have

Cement $2.51 at 1.88	$ 4.72
Stone $2.70 at 0.795	2.15
Sand $1.70 at 0.397	.67
Manipulation	2.50
Water and joints	.30
	$10.34
Profit, 20%	2.07
Waste and overhead, 10%	1.03
	$13.44
	Say $13.45

The difference is .30 per yd.

In a road 5 miles long, 18 ft. wide, section 6 in.-8 in.-6 in., Parabolic, the number of cubic yards, 10,756, at $ .30 would mean a saving of $3,226.80, which it seems would be worth a preliminary investigation before submitting bid on a concrete pavement.

CHARACTERISTICS OF KENTUCKY ROCK ASPHALT PAVEMENTS

By Rodman Wiley, Chief Engineer, Kentucky Rock Asphalt Co., Paul Jones Bldg., Louisville, Ky.

Kentucky Rock Asphalt is a natural product composed of about 92½ per cent. silica sand and 7½ per cent. of bitumen. It is quarried, crushed and pulverized to about the consistency of coarse meal. It is not heated and no material, either sand or bitumen, is added. It is transported by water from the plant to Bowling Green, the nearest available railroad station—unloaded from the barges into railroad cars, or else stored ready for shipment. It is therefore possible to make prompt shipments.

When building an entirely new road, using Kentucky Rock Asphalt as a surfacing material, an ordinary macadam outfit is all that is needed. It is rolled with either a tandem roller or else a roller of the macadam type.

The following represents a test of a sample of the sand made by the Bureau of Public Roads, Washington, D. C., 1919:

	Per cent. of Aggregate
Passing ¼ in. screen, retained on 10 mesh sieve	1.1
Passing 10 mesh sieve, retained on 20 mesh sieve	3.2
Passing 20 mesh sieve, retained on 30 mesh sieve	3.5
Passing 30 mesh sieve, retained on 40 mesh sieve	8.7
Passing 40 mesh sieve, retained on 50 mesh sieve	9.9
Passing 50 mesh sieve, retained on 80 mesh sieve	43.2
Passing 80 mesh sieve, retained on 100 mesh sieve	13.2
Passing 100 mesh sieve, retained on 200 mesh sieve	9.7
Passing 200 mesh sieve	7.5
Total	100.0%

Cheapness

Especially in Kentucky, Kentucky Rock Asphalt is the least expensive of all permanent types of pavement because it is used in such a manner as to utilize the local materials; can be laid over a limestone base, a sandstone base, and by using about 4 in. of crushed limestone can be laid over a road that has already been surfaced with bank or river gravel.

In the October, 1919 issue of "Southern Good Roads" there appears an address entitled, "Hard Surface Roads," by Mr. E. J. Wulff of the Bureau of Public Roads at Washington, delivered at the annual meeting of the North Carolina Good Roads Association, Wrightsville Beach, August 13-15. He said, in part:

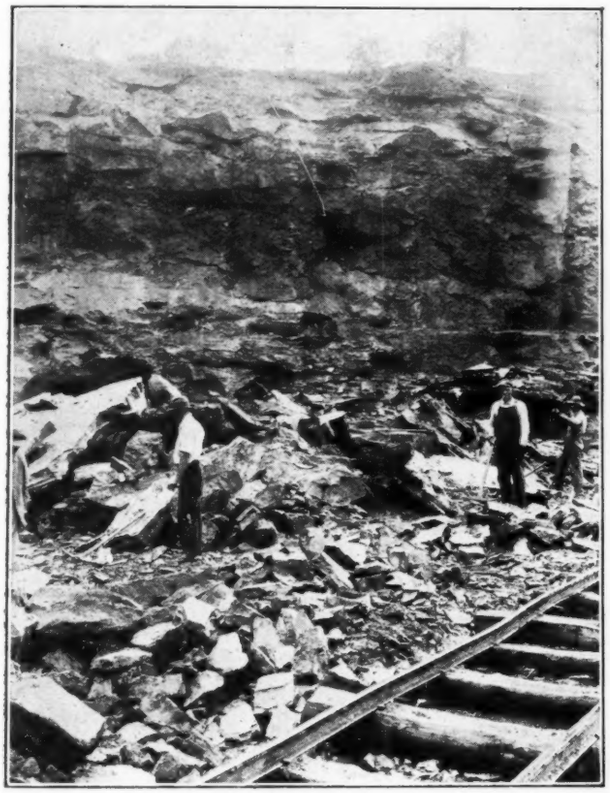
"Generally speaking, all asphalt pavements laid in the form of sheet present their best appearance if laid on a macadam foundation. By reason of the very small adjustment due to the expansion and contraction, due to temperature changes which take place in the entire surface and foundations as well, a pavement of this kind is singularly free from unsightly cracks that must inevitably appear, when the pavement is laid on a rigid foundation like concrete."

I consider it not only good engineering, but good common sense to use the local materials as much as possible.

Kentucky Rock Asphalt is laid cold, without the addition of any extra material. It is used just as it comes from the hand of nature, requires no expensive plant to lay and no expert labor. It is as near a fool proof type as it is possible to lay.

Durability

Tests show that the material which has been down for as long as 10 or 15 years is practically as live today as it was when laid. The method of laying it has been standardized after years of careful study and much experimenting; laid on a good macadam foundation it has been down for as long a period as 10 years without any maintenance, and some of the roads have been subjected to severe traffic—a mixed traffic, composed of narrow steel tired vehicles, horses and mules heavy shod, light and heavy automobile trucks, caterpillar tractors, traction engines and pleasure automobiles. In that time the pavement has shown very little wear and today is smooth, having the appearance of the best sheet-asphalt pavement.



VIEW SHOWING THE QUARRYING OF KENTUCKY ROCK ASPHALT.

Sample Section at Bowling Green

A sample section was laid at Bowling Green, Ky., in August, 1907, by B. F. Heidel of the Office of Public Roads, Washington, D. C., under the direction of Vernon M. Pierce, of the same Department. B. F. Heidel in a letter July 1912 said, in part:

"Speaking of Kentucky Rock Asphalt which was laid on the Cemetery Pike at Bowling Green, Ky., August 1907, this material was from the quarries of the Wadsworth Stone & Paving Co., on Green River, where it was prepared for use on the road by crushing. No other material either sand or bitumen, was added to change the consistency of the crushed native product. The rock asphalt applied to the wearing surface of the stone at atmosphere temperature and at no time during the construction was artificial heat applied, either to the wearing course of the stone or to the rock asphalt. Annual inspection has been made since that time by engineers from the Office of Public Roads in the Department of Agriculture. The reports show 'that the pavement has remained practically unchanged in appearance, with little evidence of wear, and the bitumen has retained its life to the present time.' ".

Columbus, Ohio Test Road

I recently returned from an inspection of the Nelson Avenue Experimental Road at Columbus, Ohio, where 17 types were laid under the direction of the Ohio State Highway Department in 1909. Today, after 10 years' service, the pavement is in excellent condition and no funds have been expended for maintenance. A sample taken from the edge of the road and analyzed by the Pittsburgh Testing Laboratory in October 1919, showed 7.42 per cent. of bitumen.

The 18th Street road out of Louisville leading to Camp Henry Knox is Kentucky Rock Asphalt for about 7½ miles. It has been down for a number of years and carries a heavy mixed traffic and for the past two years has withstood from 4,000 to 5,000 vehicles per day.

Ease of Maintenance

It is an easy type of pavement to repair. It requires no plant, no special tools, no expert labor. It is laid cold. You merely cut back the edges of a hole to where the surface is at a proper grade, leaving the edges perpendicular to the foundation, clean the hole and fill it with new material and tamp it down. A section of the pavement can be removed with a knife, the material crushed with the fingers, and the hole repaired with the same material that is taken out.

In regard to the section laid at Bowling Green, Ky., Circular No. 89, Office of Public Roads, Washington, D. C., reads in part, as follows:

"It is resistent to deformation under a load, yet sufficiently plastic to break the severity of the blow from a horse's hoof, and thus in a measure avoid the harmful effects on animals of a rigid pavement.

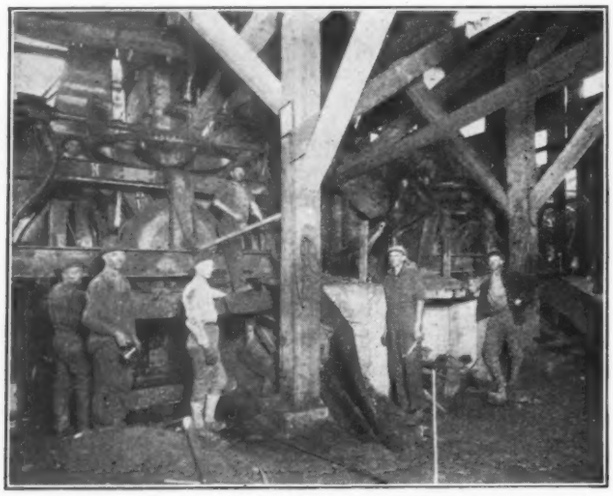
Kentucky Rock Asphalt can be laid on either a broken stone base or a concrete base, or can be used to resurface old brick streets. It has been successfully used for sidewalks. Sidewalks laid in Washington Park, Cincinnati, are good after 12 years service. The majority of walkways in the Ohio State University grounds are Kentucky Rock Asphalt, and this season about one mile has been laid at the Western Normal School at Bowling Green. It is an excellent material for the floors of warehouses, and is used extensively for station platforms, and is now being successfully used to patch sheet-asphalt and other forms of bituminous pavements, as well as macadam roads.

The material is uniform. It is tested before it goes to the crusher and again tested after leaving the crusher, and the bitumen contents runs between 7 and 8 per cent., usually around 7½ per cent."

Shipping to Distant Points

There is found in the 1914 Kentucky Geological Report the following statement by Mr. Owen Bryant:

"In considering the use of this rock in its crude form as a road building or paving material, the question arises what freight rate will preclude the possibility of competing with other products when initial cost is the prime consideration? In the first place initial cost should not be the prime consideration in a matter of this kind, as the durability of the various materials used as road coverings varies to a considerable degree. The ultimate cost, renewability and character of surface as well as the initial cost, should govern the selection of a material for this purpose. If these factors are given their proper weight in considering bids on a contract, this black rock ought to compete with any other material known with a fair possibility of success, excepting at such distances from its source as would make the freight excessive. As this rock only contains from 5 to 12 per cent. of asphalt, the freight paid would be mainly upon the sand, which together with some small amount of impurities constitutes the balance of the material, i. e., from 88 per cent. to 95 per cent.



PLANT FOR GRINDING AND PULVERIZING KENTUCKY ROCK ASPHALT. EACH MACHINE HAS A CAPACITY OF 350 TONS PER 10 HOURS.

To make the asphalt content compete with other materials when loaded down with freight charges against such a large proportion of sand, which can be very cheaply obtained by most consumers, would seem ridiculous at first, but a study of the expense of purchasing and operating machinery which will produce as thorough a mixture as nature has produced in the form of this black rock, seems to show that aside from a saving of from three to five cents per square yard of pavement in place, the black rock offers additional advantages from being a perfect mechanical mixture of the materials, requiring no preliminary heating of either the asphalt or the sand, a considerable advantage when the disagreeable features attending the use of these heated materials in a residence district are considered, more especially when portable melting and heating plants are used. It is also advantageous because it offers a surface which does not become slippery. The sand grains in the black rock pavement offer much more resistance to skidding wheels than the ordinary asphalt pavement surface will offer. In the writer's opinion, the use of any crushed argillaceous or calcareous material on the surface of an asphalt pavement will result in the production of a thin, slippery coating when the pavement is wet and heavy traffic is passing over it. Limestone or cement does not stand up under traffic, and pure quartz sand will."

The foregoing paragraphs are excerpts from the address of Mr. Wiley at the November meeting of the Kentucky Highway Engineering Association.

ECONOMIC STATUS OF GUARANTEES FOR PAVEMENTS ON ROADS AND STREETS

(Editor's Note: The matter following is from the final report of the committee on the above subject made to the American Road Builders' Association on Nov. 7, 1919. The members of the committee are: Francis P. Smith, Chairman; J. J. Hill, C. M. Pinckney, J. H. Wait and T. J. Wasser.)

KENTUCKY ROCK ASPHALT PAVEMENT ON VIRGINIA AVE., HOPKINSVILLE, KENTUCKY. LAID IN 1917 ON A BROKEN STONE BASE.

It has been suggested that it would be helpful if the Committee were to indicate what it considers a proper period of reasonable life without repairs for various kinds of pavement under different conditions. An earnest effort to compile such a table which would cover all possible conditions clearly showed, however, that the wide variation necessary in a general schedule would render the figures worthless and would probably lead to a very heated discussion as to whether the figures cited were to be regarded as a measure of the life of various types of pavement when laid upon different kinds of foundations and subjected to traffic of various densities and the attempt was therefore abandoned. Each set of conditions must be given individual consideration, and the Committee believes that the determination of such reasonable periods in any particular case would not be extremely difficult and that any competent engineer can do this satisfactorily.

The Committee's recommendation that the guarantee bond be supplemented by a cash retainer was based largely upon the difficulty sometimes experienced in having necessary repairs made within a reasonable time and was designed to provide a means of enforcing this necessary provision of any paving contract without first having to

resort to a law suit. As a rule, a municipality has no fund available for this class of work and the cash retainer therefore serves two purposes.

What a Cash Retainer Accomplishes

1st. It tends to bring the contractor back to make the repairs, as he knows he will collect some money toward the expense involved.

2nd. It gives the municipality cash with which to make the repairs and thus avoids the necessity of going through the formalities, and oftentimes difficulties, of securing an appropriation with all the attendant delays.

Percentage Retained

In this connection the Committee recommended that a greater percentage be retained on resurfacing work as compared with new construction in order to provide for approximately the same amount of retained money per square yard of finished pavement in both cases. This did not mean, as was assumed by some members, that the Committee felt that resurfacing work, properly conducted, involved any greater guarantee liability than new construction work. On further consideration of the matter the Committee believes that reasonably adequate protection would be assured to the municipality by a reduction of the amount of the retained moneys from 10 and 20 per cent., as at first recommended to 5 and 8 per cent. respectively. It further feels that such a provision cannot be justly held to be a curtailment of a contractor's working capital.

In arriving at this conclusion your Committee takes the position that 15 cts. per square yard to cover guarantee liabilities may be assumed as a fair average. On this basis the following figures may be considered as typical and illustrative of the principle involved:

	Resurfacing	New Work
Construction cost per sq. yd.....	$1.50	$2.50
10% profit	.15	.25
Guarantee	.15	.15
Total	$1.80	$2.90
Retained (8%)	.15	5% .15
Payment on completion	$1.65	$2.75

In both cases the contractor receives a payment equal to his construction cost plus profit, the municipality retaining an amount practically equal to the sum included by the contractor in his bid as necessary to cover the guarantee provisions. This amount per square yard is the same for both types of construction and has not been expended by the contractor in his work and will not be expended by him except where defects in construction have occurred. While held by the municipality, the contractor will be paid interest on it. This amount, while sufficient to cover ordinary defects in workmanship and insure the making within a reasonable time of necessary repairs, is totally insufficient to cover extensive repairs rendered necessary by serious defects or failure of the work, protection against this being assured by the guarantee bond.

The Committee further believes that the criticism that its provision as to forfeiture of all retained moneys in case of failure to make ordered and necessary repairs is too drastic, is well founded and has modified its progress report in that respect by providing that the city may make these repairs at the expense of the contractor and such expense shall be deducted from the retained money. When any part of the retained money is due to the contractor only such balance as has not been expended by the municipality shall be considered to be due and payable. When the cost to the city of such repairs exceeds the amount of retained money, the balance shall be recoverable from the sureties.

It therefore submits as its final report all of its progress report down to the paragraph commencing "For new construction involving grading," etc., and adds thereto the following:

For new construction involving grading, foundation and wearing surface, we would recommend that an amount equal to 5 per cent. of the aggregate cost of these items be retained.

For surfacing on an old foundation we would recommend retaining an amount equal to 8 per cent. of the cost of surfacing.

In the case of a 2-year guarantee the whole of the retained moneys should be payable at its expiration and not before. In the case of a 5-year guarantee, one-fourth of the retained moneys should be payable two years after the completion of the pavement and the balance in three equal installments. The date when payments of retained moneys become due shall be governed by the clause previously recommended for pavements completed and accepted between November 1st and May 15th.

If the contractor, having received notice from the engineer, fails to make and complete the ordered repairs within a reasonable time (not to exceed 30 days in any case) the city shall have the right to undertake and complete the ordered repairs at the expense of the contractor or his sureties.

PROPER GRADE OF CREOSOTE OIL FOR WOOD PAVING BLOCKS

By K. M. Waddell, Chief Chemist, The Jennison-Wright Co., 2463 Broadway, Toledo, Ohio

A great deal has been said about the proper grade of creosote oil for the treatment of wood paving blocks, but it is seldom definite reasons are given in support of the grade advocated that can be understood by the layman. The present article is free from chemical formulas.

The requirements of an efficient wood preserving oil, particularly one that is adapted to the treatment of pav-

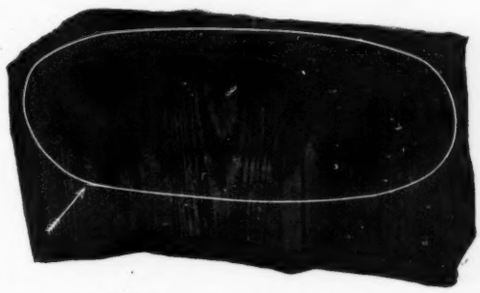


FIG. 1. THIS WOOD PAVING BLOCK TREATED WITH A DISTILLATE OIL WAS UNDER TRAFFIC THREE YEARS AND LIGHT OIL EVAPORATED.

After a heavy rain the block absorbed moisture as shown above; rain was followed by a severe freeze which expanded the blocks, the line of demarkation shows how far the moisture penetrated, and the pavement buckled.

ing materials, are very high, and a great many failures are directly traceable to a lack of consideration of the necessary qualifications.

Characteristics of a Good Oil

We may briefly summarize the most important needs of a good oil as follows: 1, toxicity; 2, waterproofing values; 3, permanence; 4, penetrance.

The oil must be highly toxic in order to prevent the growth of the small decay producing plant organisms by poisoning all the food with which they come in contact. It must be impervious to water, in order that the

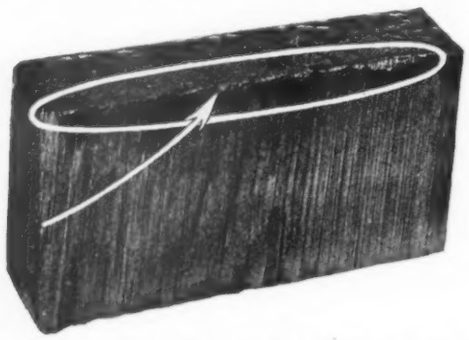


FIG. 2. THIS BLOCK WAS TREATED WITH KREOLITE OIL, UNDER TRAFFIC THREE YEARS, TAKEN UP AND FACE IMMERSED IN WATER 24 HOURS.
Arrow shows that moisture did not penetrate appreciably.

moisture content of any untreated portion of wood on the interior of the timber does not become high enough to promote decay. Further, the absorption of water causes the wood fiber to expand with an almost resistless force, sometimes ending in disastrous results if adequate provision has not been made to take care of this expansion. It must be permanent in that both of these characteristics are retained indefinitely and are not depreciated by a loss of the valuable ingredients through evaporation or leaching. Finally, it must be a good penetrating oil in order that wood is treated to the greatest possible depth.

It is not reasonable to expect to meet all the requirements of an efficient preserving oil with any single oil taken just as it comes from the manufacturers, for in every instance these particular oils exist as by-products of some phase of the coke and gas industries, and consequently are not manufactured with the same degree of uniformity as would be the case were they made the principal product instead of the by-product. The result is that we can only produce an oil of the desired characteristics by carefully compounding a number of oils whose characteristics have been individually determined by careful technical analyses.

A Blended Oil

Kreolite oil, which is a product of the Jennison-Wright Company, is just such a blended oil. It is compounded from analyzed oils to the exact formula which technical research and practical experience have shown to represent the most efficient timber-treating oil.

Kreolite oil is a highly antiseptic oil, as laboratory tests have shown that it contains from 10 to 20 times the amount of toxic materials necessary to prevent decay. But the real criterion as to the permanent toxicity of an oil is found in the length of life of the treated material under actual service conditions, and here our records are incomplete for material treated with Kreolite oil has never been known to decay. Its permanent toxicity and waterproofing values are largely due to the manner in which certain light and heavy oils are blended. These oils are mutually soluble in each other, there being just enough of the lighter and more volatile oils to completely flux the high boiling oils at the treating temperature. Upon exposure there is an evaportion of the extreme light oils in the outer layer of cells, leaving the heavier oil as an impenetrable film. This action is analogus to the formation of a paint film due to the evaporation of the lighter solvent, except in this instance probably an evaporation of less than 1 per cent. is sufficient to protect the bulk of the oil, as practically all of it is contained within the interior of the block, out of contact with the air. The formation of this film, of course, prevents any further evaporation of oils or the passage of moisture in or out of the wood.

Surface Tension

The efficiency of a waterproofing surface is evidenced by the phenomena of surface tension, or the force that draws a drop of water into a ball on the leaf of a pond lily, or the gathering together of mercury spilled on a non-attractive surface. If a drop of liquid is brought into contact with a surface of material for which it has no affinity, the attraction of the particles of liquid is principally inward and towards its center of gravity, and the drop assumes a spherical shape. In fact it is apparently surrounded by an elastic bag which holds the liquid together and prevents it from passing into the surface with which it is in contact. On the other hand, if there is an affinity between the liquid and the surface of the solid, the outward attraction reduces the surface tension, destroying the elastic bag effect with the result that the drop flattens out and the individual particles of

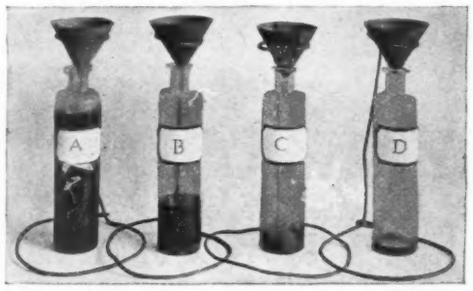


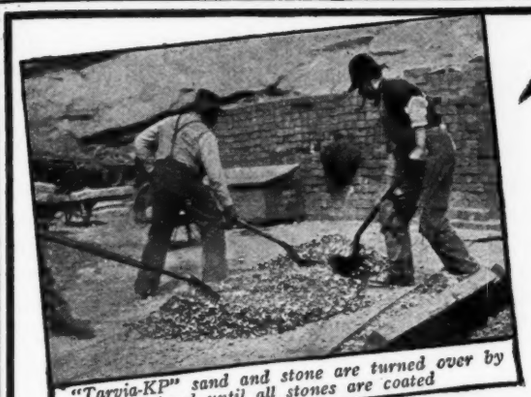
FIG. 3. SHOWS THE COMPARATIVE AMOUNT OF WATER PASSING THROUGH OILED FILTER PAPERS IN TEN MINUTES.
A treated with light distillate, B medium distillate, C heavy distillate and D Kreolite oil.

the liquid pass into the interstices of the solid. The two cases represent a waterproof and a non-waterproof surface, respectively.

Some Simple Experiments

That the surface tension of water is higher when in contact with Kreolite surface than it is when in contact with a surface treated with an ordinary coal tar distillate is easily proven by a simple experiment.

Take two filter papers or blotters of the same degree

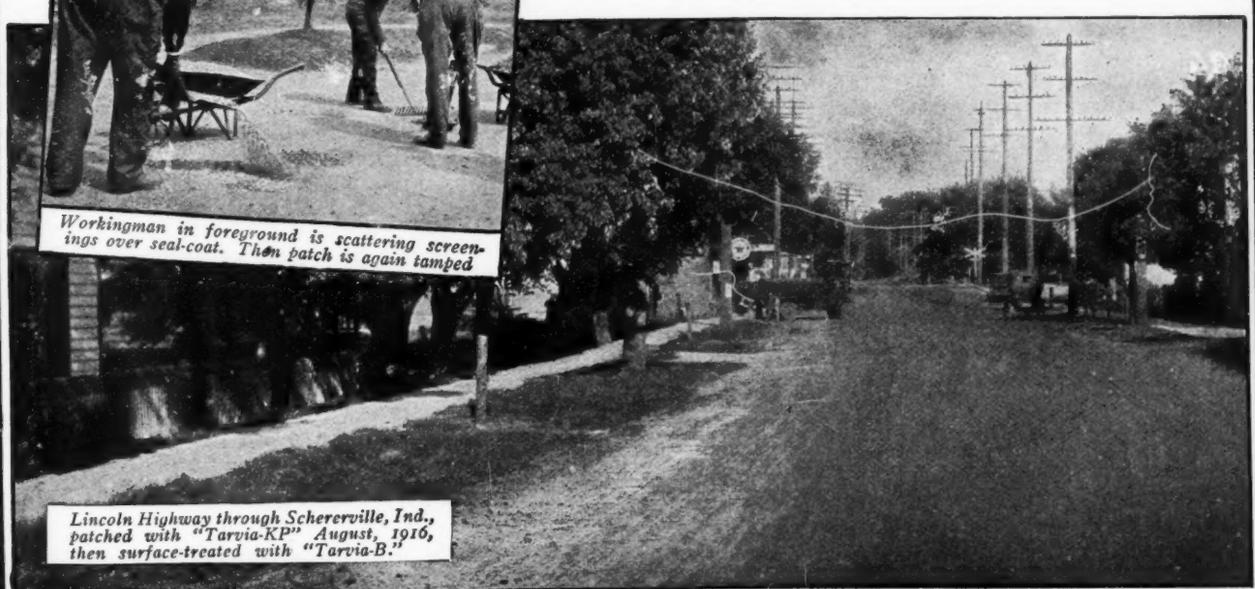


"Tarvia-KP" sand and stone are turned over by hand until all stones are coated

The hole to be patched is cleaned out and the bottom and the sides are painted with "Tarvia-KP"

The mixture is shoveled into the hole and is well tamped

Workingman in foreground is scattering screenings over seal-coat. Then patch is again tamped



Lincoln Highway through Schererville, Ind., patched with "Tarvia-KP" August, 1916, then surface-treated with "Tarvia-B."

Tarvia-KP

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—used now will save dollars later!

"TARVIA–KP" is the highway official's "handyman" for quick, dependable patching work on every type of road.

Used now, it will save many dollars of expensive repair work in the Spring. Freezing won't hurt it!

Hundreds of highway officials use Tarvia throughout the winter whenever the roads are free from snow. Thus they fortify their roads against the destruction of winter, and are able to get an early start with their spring surfacing.

The illustration shows how easy it is to use this remarkable *cold* patching material. "Tarvia-KP" is practically fool-proof. Can be stored up in spare moments and used at any time. Order some now.

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TABLE I—COMPARATIVE AMOUNTS OF WATER PASSING THROUGH FILTER PAPERS TREATED WITH DIFFERENT TYPES OF PRESERVING OILS, AS A TEST OF THEIR WATER PROOFING VALUES

(The Apparatus used in this test shown in Fig. 3)

Kind of Oil	No. of Tests	Appearance of First Drop	Total Through in Ten Minutes
A—Light Distillate	6	3 seconds	203 cc
B—Medium Distillate	5	10 seconds	58 cc
C—Heavy Distillate	6	39 seconds	15 cc
D—Kreolite Oil	13	150 seconds	3 cc

of porosity and on one of them place a drop of distillate oil and on the other a drop of Kreolite oil. Allow the oil to spread out and dry for a few minutes and then on each oiled surface place a small drop of water. In a few moments the water spreads out on the distillate oil surface and is quickly absorbed by the pores of the paper, while in the case of the Kreolite oil surface the water assumes a permanent spherical shape and usually evaporates before it penetrates the surface. It is needless to point out the comparative efficiency of the two surfaces.

A modification of this experiment is obtained by dipping filter papers into the oil, allowing them to dry, rolling them into little filter funnels, filling them with water and measuring the amount of water that will pass through in a given time. A number of experiments were conducted along this line, the results of which are shown in Table 1, and the apparatus is shown in Fig. 3. These results compare very favorably with the results obtained by soaking blocks treated with the different oils and weighing the amount of water they will absorb.

The penetration of oil into wood is not alone a function of its viscosity but is largely dependent upon the amount and size of the particles of oil-insoluble matter which are suspended in the oil. A great deal of attention is paid to this point in the blending and use of Kreolite oil, and largely for the purpose of keeping this insoluble matter to a minimum our filter press was installed. We know of no other instance where a filter press has been installed and operated for the single purpose of maintaining the quality of a preserving oil. The result of this treatment, however, is an oil which always yields a satisfactory penetration.

As we have said previously in this article, the blending of Kreolite oil is not a hit or miss proposition, but it is compounded with an accuracy only attainable by scientific control. For this purpose, a complete and modern chemical laboratory has been installed and is in constant use.

From these data it is then possible to calculate the exact amounts of each material to bring the resultant blend up to the Kreolite formula, and this is finally confirmed by a complete analysis of the finished product, which should show an exact reproduction of the Kreolite standard.

AMERICAN PLANS FRENCH RECONSTRUCTION

Major George B. Ford, who was official town-planning consultant of Newark, N. J., has been with the American Red Cross in France since 1916, studying the reconstruction problems of the country as a member of various commissions. Under a recent French law, every community that has been wrecked, or even partly wrecked, in the war, must have a town plan drawn up. Before a single permanent building can be constructed in any community this plan must be approved by the provincial authorities, and by the Minister of the Liberated Regions. Major Ford has now been appointed town planning consultant of the French government, and will have the final decision upon the new plans of 3,000 devastated towns and cities of northern France. Major Ford is best known for his work at Beloit, Wis., in the model town of the Fairbanks-Morse Company. He is author of the New York building law. In France he has participated in many governmental conferences to explain his plans. An official of the French Ministry of the Liberated Regions said recently: "This new law, and the present movement in France to seize this opportunity to beautify northern France in the rebuilding, owe a great deal to this American Red Cross engineer, who has been a veritable missionary in France of town-building."

TRADE NOTES

Washington has been selected as a district headquarters by the Asphalt Association, whose main office is in New York. This is another evidence of the growing industrial importance of the Nation's capital, as most of the large industries are now recognizing that decisions of great moment are constantly being made by Federal departments and bureaus. The Asphalt Association is composed of the leading producers of asphalt and maintains a corps of engineers, chemists and economists to aid in working out problems of highway construction and maintenance involving such types as sheet-asphalt, asphaltic-concrete and asphaltic-macadam. It is estimated that this year more than 40,000,000 sq. yds. of these types will be laid in the United States, the Nation's capital having the unique distinction of having the largest percentage of sheet-asphalt pavement of any city in the United States.

Maj. Harry D. Williar, one of the most brilliant engineer officers in Pershing's famous First Division, will have charge of the Washington office of the Asphalt Association in the Munsey building. Major Williar is a Marylander, receiving his training as an engineer on the State Road Commission and later with the Paving Commission of Baltimore. At the outbreak of the war he entered the officers' training camp at Fort Myer and was one of the engineer officers selected to go to France with the original Pershing expedition. Included in the Washington district are the states of Maryland, Pennsylvania, Delaware, Virginia and West Virginia.

The Franklin Institute, acting through its committee on Science and the Arts, has awarded its Edward Longstreth Medal of Merit to John Walter Ledoux of Swarthmore, Pa., for the Simplex Venturi Meter manufactured by the Simplex Valve and Meter Company of Philadelphia.

WATER WORKS SECTION

HYDRO DEVELOPMENT FURNISHES POWER FOR MUNICIPAL WATER SUPPLY

By Edwin C. Hurd, Assistant to Charles H. Hurd, Consulting Engineer, Merchants Bank Building, Indianapolis, Ind.

That turbines may be used advantageously on low head water power installations has been recently demonstrated at the plant completed at Rockford-on-White River, near Seymour, Ind. Operating on a minimum head of less than 4 ft. the new plant successfully furnished the city of Seymour with water, even before the dam was closed. This was made possible by a specially constructed tail-race of careful design, extending about 300 ft. down-stream from the pumping station.

Previous to the installation of the hydraulic plant, water was supplied to the city of Seymour by a steam plant which was operated with fair success. However, with the outbreak of the war and increase in the price of coal and other added expense, the management gave consideration to more improved methods and sources of economy, which resulted in the water power development.

The present pumping station is located on the east bank of White river, at the site of the "old ford," at which was located the old Rockford Mill. This mill was originally operated by water-power, the head being produced by a low timber dam which was anchored into the flat rock composing the bed of the stream. The river has but a very slight fall, which, with the somewhat limited possibilities for back-water, made the problem intricate when consideration was given to the cost of construction consistent with the economies to be obtained.

About five years ago, in connection with construction of filters for the purification of water, a 3-ft. concrete wing dam was built on the rock foundation for about one-third the distance across the river, and angling slightly up-stream from the pump house site. This dam was made use of in the new project, by first constructing a 5-ft. concrete dam from the opposite shore for about one-third the distance, then by a closure with a 3-ft. section in the intermediate third. The two 3-ft. sections are equipped with automatic crest gates to operate at times of high water or flood.

While the water rights acquired through the purchase of the mill permitted the construction and maintenance of a 6-ft. dam, an analysis of flowage in the river proved that by use of ordinary construction such a dam would be practically submerged throughout a considerable period and available power could not be exepected on an average for more than nine months during the year. It was conceived by the expenditure of an amount equal to the additional cost of a 6-ft. dam, in the development of the tail-race and the construction of a diverting wall below the power building, that sufficient power would be available for pumping purposes for at least eleven months during the average year. This construction which tends to divert the flow, as well as to increase the velocity of the current in the main channel and being most effective during the periods of high water, has proved extremely satisfactory and more than the estimated results have been realized.

The features of more than usual interest in the power and pumping plant installation are the methods of direct

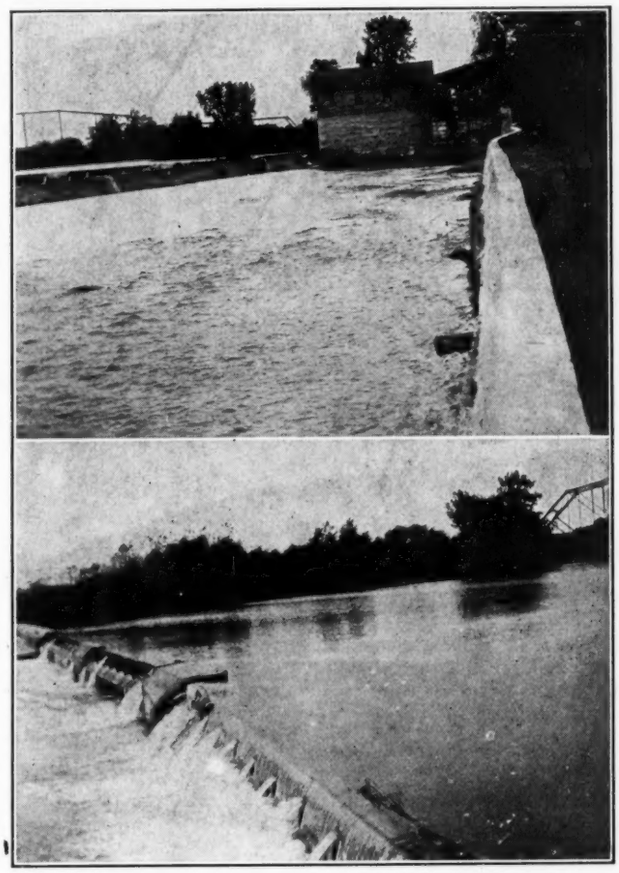


FIG. 1. HYDRO POWER STATION OF THE SEYMOUR WATER COMPANY LOCATED AT ROCKFORD, INDIANA, SHOWING FLARING CONSTRUCTION OF TAIL RACE.

FIG. 2. UP STREAM VIEW OF LOW DAM ROCKFORD HYDRO INSTALLATION SHOWING CREST GATES IN OPERATION.

connection of the turbines to the high pressure power pumps without intermediate transmission and the fact that the seasonal demand for power corresponding to the use of water varies inversely as the stage of the river which gives maximum power during low water periods, making the plant more or less automatic, and to a degree, self-regulating.

The turbines for the plant are 52-in. diameter, improved vertical type, furnished by the Leffel Company, Springfield, Ohio. The power pumps are of the heavy duty,

Printed as insert to Municipal and County Engineering, Chicago, Ill., December, 1919.

double acting plunger pattern, built by the American Pump Company and supplied by the Dravo-Doyle Company of Pittsburgh. A single-stage centrifugal pump delivers raw water under low head into the sedimentation basin of the filtration plant. This pump was furnished by the American Well Works and is driven from the main power shaft, as is also the electric generator for lighting and general use.

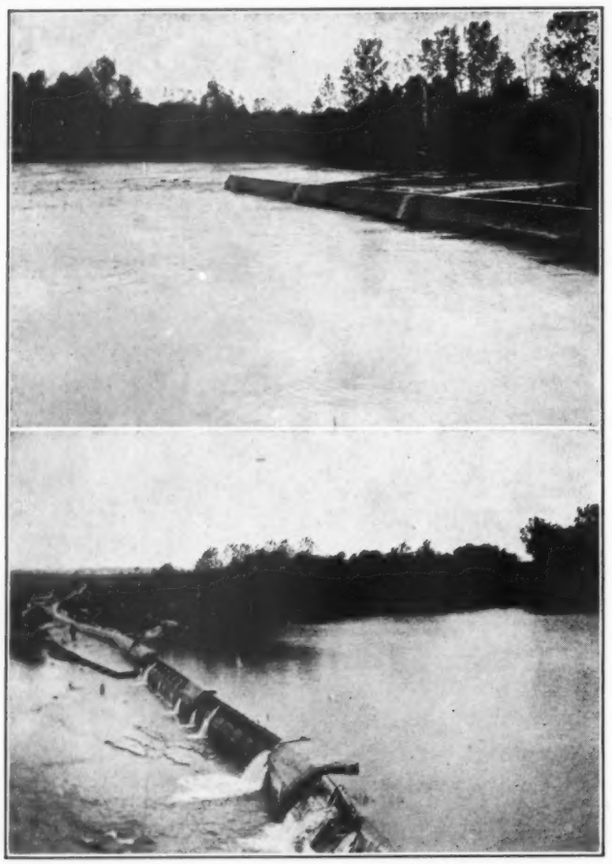


FIG. 3. DOWN STREAM VIEW SHOWING JUNCTION OF TAIL RACE WATER WITH THE MAIN CURRENT. Note the swells and wave action on opposite shore due to high velocity in main channel.
FIG. 4. BED OF RIVER BELOW THE DAM DURING LOW FLOWAGE AND CONDITION OF MAXIMUM POWER.

The success of this installation demonstrates in a striking manner the possibilities of developing power for lighting or pumping service for municipalities located on or near rivers and streams, and present conditions relative to the cost of fuel and the more recent attitude of legislative regulating bodies concerning the use of water for power purposes, increases the tendency toward this class of construction and investment.

MUNICIPAL WATER AND LIGHT PLANT MANAGEMENT

By J. C. Manning, City Manager, Hays, Kansas.

In discussing the subject of municipal light plant management, I wish also to touch upon municipal water plants in connection with light plant management, as in so many municipalities you find both under the same management, said Mr. Hays in addressing the League of Kansas Municipalities.

In my first report to the Commissioners of Hays, and analysis of conditions as I found them. I prefaced it with the statement that it was not unlike any other city of the same size and class. In this report I called attention to the waste and inefficiency of management and I will venture to say that the same conditions that existed in Hays exist in 80 percent of the cities of Kansas, or any other state for that matter, and I feel that the few that are the exception to this class will bear me out in what I have to say and I trust that all will feel that the criticisms that I offer are of the constructive type and not destructive.

Many Municipal Plants are Inefficient

Mr. Emerson McMillan, Chairman of the Board of the American Light & Traction Company, in his address on public ownership of public utilities before the National Civic Federation in New York on September 11th, made this statement: that municipal ownership of public utilities is unsuccessful at the present time, and will remain so as long as the present form of city government exists, saying that plants under private ownership are not only more efficient, but give a better service at a lower cost to the public. Mr. McMillan stated that the cost of municipally owned utilities is usually higher when all the legitimate items of expense are given consideration, and the equipment installed in a municipally owned plant is usually too poor for efficient service or is badly adjusted to the operating demands and gives as the cause of this the lack of business methods and lack of organization. The sad part of the whole matter is that in most cases of municipal ownership it is just as Mr. McMillan has stated, although it is not necessary that it should be and the reasons for such a condition are easily explained. First, it is caused by the employment of inefficient help and second, by political interference.

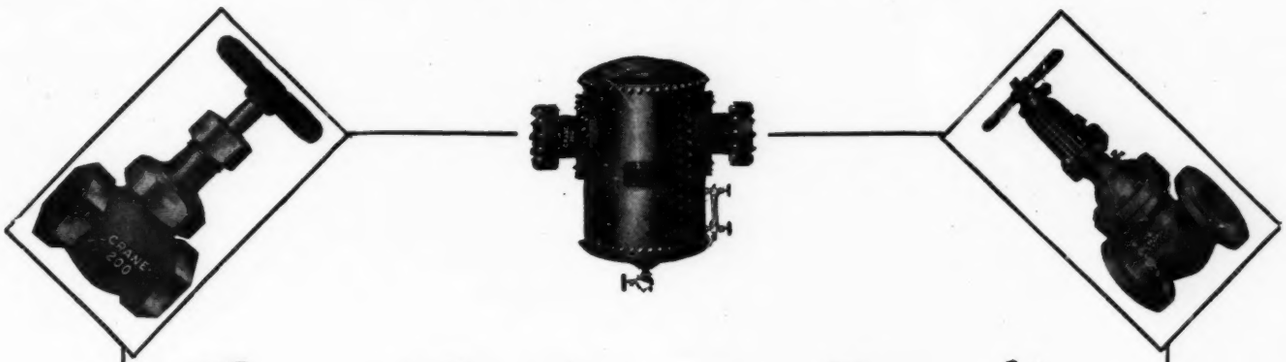
Plants Do Not Know Their Costs

Very few municipally owned light plants know whether they are running on a paying basis or not. Especially is this true of the smaller cities and villages as very few of them know the value of their light plant, what the total output is, what they have spent for repairs, reconstruction, plant additions, or overhead. This information can only be brought about by the installation of proper instruments and meters and by the introduction of proper time cards and cost finding methods.

A great many cities who employ a manager or superintendent for their light plant and water plant, pay him a good salary and then handicap him by curtailing his authority and expenditures, as the average man in civil life may not readily see the advisability of spending $300 to $500 for meters and instruments that he personally cannot see the use of.

Value of Operating Records

For instance, I have been called upon to analyze the condition of cities and when I get there, find they are making a special rate for some industry or firm without the faintest knowledge of what their current is costing them. No successful retail merchant would undertake to sell goods without knowing the cost of the commodity. Think of a successful baker selling bread without knowing what his flour, yeast, potatoes, salt, sugar, shortening and labor cost him. Still, when he gets on a city council, he will permit the sale of electrical energy without knowing the unit cost per kilowatt hour of coal, water, boiler



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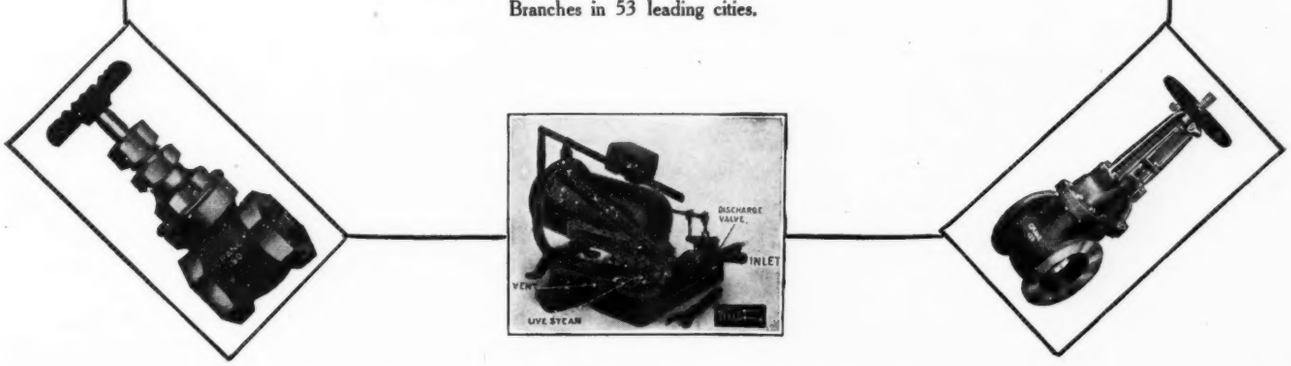


compound, labor, interest, depreciation and overhead, and little does the average councilman know that the cost of production is greater at certain hours of the day than at others. In many cases the unit working is not an economical one for the load they are carrying.

For instance, I recently visited a plant where they were firing two 150 H. P. boilers for 35 kil. hour load or about ¼ load for one boiler. When I asked the fireman why he was running two boilers, his reply was so as to have plenty of steam when the load comes on. Now, had that plant installed indicating watt hour meters and kept a log sheet recording the load every hour, the fireman would know at just what hour in the day his peak load would come on and he could have carried a bank fire in one boiler until about an hour previous to the time this load would come on. This log sheet would also show the manager of this plant which fireman was producing the best results and entitled to the highest wages.

In other plants I find cities furnishing electricity for pumping water where they have been very careful to meter the current used in pumping water but paid no attention whatever to how much water they were pumping. Consequently they had no way of knowing the cost per 1,000 gals. of pumping water. In other plants they had the light and water plant in the same building, the same boilers furnishing steam for both plants without any way of determining the distribution of the steam between light and water.

Plant Management

The greatest cause of failure of municipally owned utilities, is on account of the interference of the city officials. In privately owned plants the directors employ a manager and put him in charge of a plant with full authority. When he comes in with a requisition for material or equipment and can show the directors that it is necessary for economical operation or a good investment, it is purchased for him, or if that manager discharges an engineer or some other employe for incompetency, he is upheld in his act. While in most cases of municipally owned plants the manager or superintendent must go before the city council and tell his troubles and they leave the purchasing of the equipment desired to some one that knows nothing at all about the working conditions or the quality of the article in question but purchase the equipment wherever it can be purchased the cheapest without the least regard for quality or adaptability and when he discharges some one, he stirs up a hornet's nest.

An Example of Political Interference

For illustration, in Kansas City the mayor started out with good intentions. He employed a high-class business man and put him at the head of the board of public works. Business methods not fitting in with the organization of the board of public works, he was transferred to the head of the water board. Likewise, business principles failed to fit in here and he was asked to resign. When I read of this, the Kansas City Star Slogan "Do you Know" struck me, but after a wait of about 30 days the "Do You Know" was answered by the Star itself, when it stated that the mayor wes feeling his way towards the governorship of Missouri and the mayorship of Kansas City. This gentleman is the very best illustration of why most municipally owned utilities do not pay.

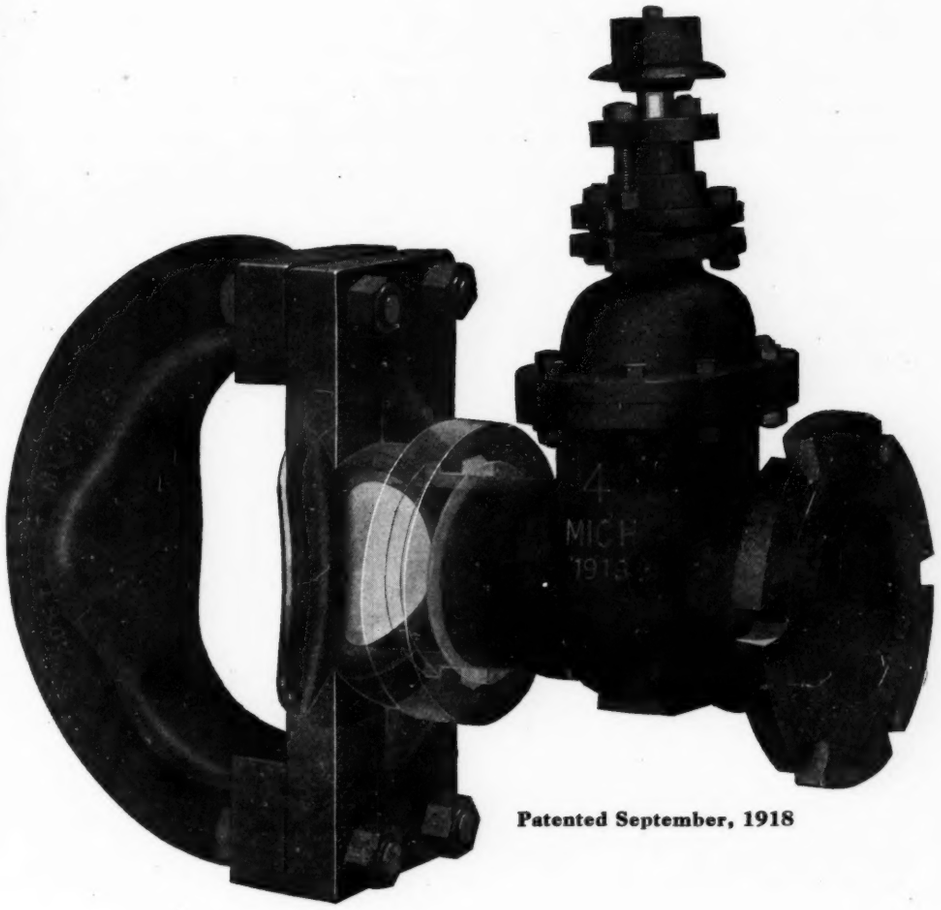
How to Run a Light Plant Efficiently

Municipally owned light plants can be run successfully in any city under proper conditions. It must have a manager or superintendent capable of running it and that man should have full charge. I do not mean by this that he should be turned loose with no one to check him but he should be chosen after careful consideration of his ability, personality and habits; and after being chosen he should be allowed to demonstrate his ability and if not successful should be removed. He should be under the supervision of the Board of Public Works, or the Light and Water Committee if it is a city of councilmanic form of government. His authority should extend to all branches of city service in which his department is effective. For instance, if it be a municipally owned light and water plant, he should be in full charge of office, plant, lines, public watering places, sewers, etc. All purchases should be made on requisition and as far as possible should follow the requisition to the letter.

In operation there should be no difference between municipally owned utilities and privately owned. There should be complete valuation of all utility property, complete records kept at the power plant. All coal, ash, water, should be weighed, fuel oil metered, feed water temperature recorded, log sheets should be kept showing all this, also indicating watt hour load at all hours. All current should be metered, including street lights, at the switch board, all services should be metered, meter records should be carefully kept both in the field book, in the ledger, and in addition to this, a card index of each meter showing manufacturing number, city number, and a complete history of the meter showing dates of test, repair and change of location.

All time cards should show careful distribution of time, separating repairs, reconstruction, inside wiring, and attention to service and assistance to other departments. Stock room sheets should be kept, showing material used on each job as this will be the check against perpetual inventory sheets. Carbon copies should be made of all work orders, and a work order should be made for each job no matter how small. Courtesy and service should be the watchword and the meter man should be one of the most carefully chosen of the entire organization as he is in contact with the customers more than anyone else. I am a firm believer in the Statler idea—"The customer is right," and I find it a great deal easier upon listening to complaints to say that maybe we are in error than to say that we are right and then have to apologize.

The commission manager form of government was adopted in Hays April 5, 1919. Upon taking over the city managership, I found waste and inefficiency at every turn. The municipal light and water plant lost $5,500 the previous year and $2,300 in outstanding accounts. It was a fitting example of the conditions I have sighted. In 6 months we have spent $3,500 on putting the light plant in shape, have increased the returns 75 per cent. by cutting out waste and making collections and are giving much better service. How did we do it? By applying business principles to city government, by having a set of commissioners that are clear thinking business men,



Patented September, 1918

A Cleaner, Quicker Job

The improved Flower Sleeve has quickly won nation-wide approval for it has simplified one of the most troublesome jobs facing municipal engineers.

A shallower trench can be used, as it is necessary merely to fully expose the pipe. The lead is around the tap only, not around the main.

The lead is firmly dovetailed into the sleeve in its making. There is no pouring of lead on the job.

Little or no caulking is required, as the lead is fitted to the contour of the pipe. A great saving of time is effected, as the slowest, most laborious work is eliminated entirely.

All that is necessary is to bolt the sleeve and tapping valve in place and tap with any standard tapping machine.

The saving in time, labor and lead is surprisingly great, especially in the larger sizes.

Flower Valve Manufacturing Co.

117 Parkinson Street **Detroit, Michigan**

(23)

who back the manager to the limit and at the same time keep thoroughly posted on what is going on.

In conclusion I want to say the last and greatest duty of a manager is to see that all bills are collected on date of maturity. It is a strange thing to me that so many plants have such large outstanding accounts when all they need to force collection is a screwdriver. But I find in a great many municipal plants they are afraid to use it or are not backed by the city officials when they do use it.

POLLUTION OF DEEP WELLS AT LANSING, MICHIGAN

By Major Edward D. Rich, State Sanitary Engineer, State House, Lansing, Mich.

The population of Lansing is estimated at about 60,000, and its area is about 16 square miles, only about two-thirds of which is fully built up.

Wells

The city has always been supplied with water taken from deep wells. There are 32 such wells in use at present, which vary from 350 to 400 ft. in depth and take their supply from what is known at the "Coal Measure" sandstone. The rock formation is covered with from 20 to 100 ft. of sand, gravel and mixed clay. Various strata are encountered between the bottom of the overlying earth and the water-bearing horizon.

The wells are cased with iron pipe driven a short distance into the upper rock layers, but it is doubtful if these casings fit tight enough against the rock walls to exclude any seepage that might follow down along the casing. On account of the age of some of the walls it is possible that some of these casings have deteriorated enough to permit some leakage through the pipe itself. The casings vary in diameter from 8 to 20 ins. and the present water consumption is about 8,000,000 gals. per 24 hours.

Pumping

There are five separate stations pumping directly into the distributing mains. Central station is situated just east of the center of the city. Pennsylvania Ave. station is about a mile south of Central station; Seymour street station is about a mile and a quarter northwest of the Central station; Townsend Street station is in the southwest part of the city, at the corner of Isaac and Townsend sts., and Logan street station, the last constructed, is about a mile west and a little north of Central station. Originally, many of the wells flowed to a slight extent but there was not sufficient head to furnish any great quantity of water and pumps were installed.

Suction Pipes

As the demands of the city grew and the pumping increased in volume the ground water level receded to some extent and it became necessary to install deep well pumps at Central station to increase the yield. Logan St. station being on higher ground than the rest was equipped with a triple stage deep well pump, electrically driven, when it was constructed. Pennsylvania Ave., Townsend St., and Seymour St. stations are all pumped through horizontal suction mains connected to each of the wells. The length of the suction main at Pennsylvania Ave. is about 3,500 ft. and at Townsend St. about 1,000 ft. while the Seymour St. line is considerably shorter. At each well a drop suction pipe extends down into the casing for about 20 ft., leaving an annular space of about half an inch between the pipe and the casing. The drop pipe is connected with the horizontal suction line by means of a "T" just above the top of the casing. The top of this "T" is tightly capped. Between the "T" and the horizontal suction line there is a gate valve and a check valve.

The growth of Lansing during the past five or ten years has been very rapid and it has been difficult to obtain enough water from the city wells to supply the rapidly increasing demands. Consequently it has been necessary on account of increased pumping to maintain a heavy suction vacuum particularly at Pennsylvania Ave. and Townsend St. On account of the depth of the wells they have always been considered pollution proof. For this reason, and also because in the early days the nature of the transmission of water-borne diseases was not clearly understood by water-works officials, insufficient precautions were taken to make the joints at the top of the wells absolutely tight.

Improved Pipe Connections

In later years apprehension of the possible entrance of pollution has led to the use of more efficient pipe connections. This has been accomplished by means of flanges on both the drop pipe and the casing with a rubber gasket securely bolted between them. This, of course, insures a water-tight joint if reasonably good workmanship is available. When some of the older wells were constructed it was attempted to obtain a watertight joint by placing concrete around the opening between the drop pipe and casing and extending it up a few inches to form the bottom of the valve chamber or manhole built over the well to give access to the valve. These valve chambers are not watertight, and particularly at the Pennsylvania Station they have been regarded as a source of possible contamination, inasmuch as they are subject to flooding at times of high water from the Red Cedar River, which carries a considerable sewage flow from the eastern part of the city and from the City of East Lansing. It is believed however that most of the wells at the Pennsylvania Station were constructed with flange and gasket joints. It has been customary to collect samples at this station whenever high water indicated the possibility of contamination, but only once or twice has anything suspicious been discovered.

The clearness of the water, the depth of the wells, and the absence of epidemics or serious sickness all tended to create a false sense of security and led to a lack of that watchfulness which should always be maintained over every water supply. The upper layers of the rock are coarse, poorly cemented, and very likely to develop fissures capable of transferring laterally any pollution which might reach these openings through abandoned wells or other excavations deep enough to communicate with them.

Townsend St. Station is on Townsend St. at the foot of Isaac St., and only about 200 ft. from the Grand River. Townsend St. runs approximately parallel to the course of the river. In Townsend St. and in Ann St., which is practically a continuation of Townsend St., there are five 6-in. wells connected to a single horizontal suction line about 1,000 ft. in length. Two other wells, one 10-in. directly behind the station, and another 6-in.

De Laval

Centrifugal Pumping Units are Superior

The De Laval steam-turbine-driven centrifugal pump is so much more simple and reliable, and occupies so much less space, and involves so much less cost for buildings and foundations, as compared with reciprocating pumps, that when the question of additional pumping capacity arises, there ***is*** no question—De Laval Pumps are the only choice.

The steam economy of De Laval turbine-driven centrifugal pumps compare favorably with that of the most elaborate triple-expansion pumping units, and is superior to that of compound engines. The steam turbine is able to take the greatest advantage of higher pressures, higher superheats and higher vacuums, and can also be built in the largest sizes. De Laval turbine driven pumping units show lower operating costs than any other type of pumping unit when all operating expenses, including overhead, are considered.

An estimate of costs and efficiencies that we are prepared to guarantee will be supplied upon receipt of a statement of the conditions to be met.

De Laval Steam Turbine Co.

515 Johnson Avenue **TRENTON, N. J.**

(96)

about 200 ft. west of the station on Isaac St. complete the series of wells.

Sewage Contamination

A sewer which serves quite a large portion of the southwestern part of the city extends along Townsend St. and Ann St. and lies only 10 or 15 ft. from some of the wells. This sewer discharges directly into Grand River above the pumping station. During normal stages of the river this sewer has a free outlet and no excessive pressures are maintained in the pipe. At times of high water, however, the river rises to such height as to set back the sewage to a height above the tops of most of the wells connected with the Townsend St. station. Under such circumstances, of course, this sewer is under hydraulic pressure, and the joints being far from tight offer a ready means for sewage to percolate through the sandy soil into the valve chambers.

This pumping station has for a number of years been looked upon with a certain degree of suspicion and it has been customary to shut it off during high water stages. When this is done the ground water rises nearly to the top of the casings, thus preventing an extensive amount of pollution from settling into the wells and reaching the lower level. But when the station is running and drawing heavily upon the wells there is a strong tendency to draw in polluted ground water through any leaks that might be present in the suction lines. Heavy rains caused the Grand River to rise 8 ft. on March 15, 1919, reaching a river stage of 12 ft. This placed a static head of 2½ ft. on the sewer at the wells and forced concentrated sewage into sandy soil around them. Through an oversight the station was not shut down at that time and the vacuum of 22 in. normally maintained pulled in such a quantity of highly polluted ground water that dysentery was epidemic by the 18th.

Dysentery Epidemic

The first complaint reached the State Department of Health from the Olds Motor Works, a large factory located about a quarter of a mile west of the Townsend St. station, that a large number of their men were sick from bowel trouble. The Department collected a sample of water and took action by ordering the station shut off at once. On the 20th a notice was published to boil all city water used for domestic purposes and the water department was directed to make the arrangements necessary for chlorinating the supply by means of the emergency machines furnished by the Department of Health. Systematic sampling of the supply at all the pumping stations and at various points on the distributing systems was begun at once. Seymour St. station alone showed safe results and has since continued to do so with one or two minor exceptions, all others being reported as unsafe or suspicious. On March 25th arrangements had been completed for chlorinating at the rate of 1.5 p. p. m. at Central and Pennsylvania Stations. Continued flushing of dead ends was ordered and this, together with the chlorination, resulted in sterilizing the water in the mains by the 29th. Chlorination has been maintained ever since.

Inspection and Repairs

On the 22nd the Townsend St. wells were carefully inspected and a plainly audible leak was found at the top of well "C." There was also a poorly made and leaky shred-lead joint at well "D." A defective flange at the top of the casing of well "H" was also admitting surface water which although some distance from the sewer was probably polluted to some extent. All the other wells appeared to be tight. The old manholes were torn out and all the wells ordered repaired. This was done with standard flange couplings wherever possible. In some instances it was found impossible to lift the drop suction pipes for the purpose of fitting the flanges. In these cases the casings were cut off a few inches below the "T" and a poured lead joint about 6 in. deep was put into the annular space and thoroughly caulked. There is no doubt that such a joint is fully as impervious as a flange coupling. Concrete manholes were ordered built at each of these wells.

After these repairs were completed samples taken from the Townsend St. station, which had previously been connected so as to pump to waste for sampling purposes, showed continued gross pollution. It was attempted to obtain samples from the individual wells by shutting off all but one and pumping that in the usual way. This proved unsuccessful, however, due either to inability to shut the valves at the various wells absolutely tight or to the fact that the suction line and pump had become so seriously polluted as to communicate contamination to pure water, which might be drawn to the well being pumped. In order to study the individual behavior of each well sampling devices were installed at the top of each well between the "T" and the horizontal suction line. This made it possible to pump all the wells at the same time and to obtain samples from each before its output came into contact with that of the others.

After a series of about 75 samples had been collected from the individual wells the State Department of Health ordered on June 14th wells "E" and "F" permanently disconnected and plugged. Marked improvement in the quality of the water delivered by the Townsend St. pump followed immediately and subsequent samples have indicated that the other wells have slowly returned to their normal state of purity.

Typhoid Epidemic

The number of cases of dysentery which occurred during March and April is conservatively estimated at 3,000. The fact that dysentery is not a reportable disease in Michigan, makes it impossible to obtain complete statistics of the number of cases. Dysentery was followed by an epidemic of about 82 cases of typhoid fever, with eleven deaths.

It is, of course, impossible to estimate the economic loss directly due to the pollution of the Lansing water supply, but some idea of its magnitude may be obtained from the following table showing the affect of the epidemic on the employes of the Olds Motor Works.

EFFECT OF THE DYSENTERY EPIDEMIC ON OLDS MOTOR WORKS

Date	Men Absent	Output Cars
March 19	171	138
March 20	418	88
March 21	1,703	19
March 22	2,100 (shut down)	0
March 23	Sunday	0
March 24	486	104
March 25	413	137
March 26	395	123

Normal production, 150 cars per day.
Loss of wages, $30,000.

The officials of the Reo Motor Car Co. report the average number of men absent from that factory March 20th

Cast Iron Pipe in the City of Albany

From an old "Minute Book" of the Bureau of Water of the City of Albany, N. Y.—*By courtesy of Wallace Greenalch, Water Commissioner.*

At a meeting of the Trustees of the Albany Water Works, at the office of the Treasurer on the 18th March 1813.

Present—The President—Mr. Hale, Mr. Hulton & Mr. Winnerkoff.

A Communication from Stephen Van Rensselaer Esquire was read and ordered to be filed.

Resolved that the Clerk cause the following advertisement to be inserted in the Journal newspapers printed in this City, for one month—viz:

"Cast iron Conduits for the Albany water works wanted.

"Notice is hereby given, that proposals in writing will "be received by the Subscriber, in behalf of the Trustees of "the Albany Water Works, for furnishing, by Contract "One Hundred tons of Cast iron Conduits of a bore of six "inches diameter three feet in length, and five Eighths "of an inch thick—The proposals are to be accom- "panied by two pipes, Connecting together, Spigot and "faucet fashion, with an entrance of two inches, as "samples of the Casting, and must be forwarded to the "Subscriber, by the first day of May next, and are to spec- "ify the shortest time at which the above, or any less "quantity of such Conduits, can be delivered at the City "of Albany By order of the trustees of the Albany Water Works,

Albany March 1813. J. V. V. Clk"

At a meeting of the Trustees of the Albany water works, at the office of the Treasurer on Saturday the 1st May, 1813.—

Present. The President—Mr. Hale, Mr. Hulton & Mr. Winnerkoff.

The Treasurer laid before the board sealed proposals from applicants for furnishing Cast iron Conduits, agreeably to the advertisement published by the board, which when opened, were found to be as follows, viz:

1. From Thomas Trenor of Bennington, offering to furnish them at the rate of $128 per ton—of three feet in length.
2. From Elizhalet Sturtevant of New York, offering at $140 per ton of three feet in length, or $120 of two feet long.
3. From Holley & Leffingwell of Salisbury in Connecticut, offering them at $100 per ton in joints of the length of two feet each.

The Board having taken each of the said proposals into due Consideration—Thereupon

Resolved that the proposals from Holley & Leffingwell of Salisbury be accepted of; and that the Treasurer be directed in behalf of this Board to notify them accordingly, and that the Board are ready to enter into a Contract; also that the Treasurer direct said Contractors to prepare and send on to this City without delay, two hundred joints of two feet long Carefully Cast, as a fair sample of the work, agreeably to a description to be hereafter drawn or drafted by the Superintendant and rendered to them, in order that

There is now 164 miles of cast-iron pipe in the water system of the City of Albany, and much of the pipe bought in 1813, though not now in use, is still in the ground in perfect condition.

THE FIRST CAST IRON PIPE EVER MADE IN THE WORLD'S HISTORY IS STILL IN SERVICE
SERVICE
CAST IRON PIPE
MEASURED BY
CAST IRON PIPE
CENTURIES
MORE THAN 250 YEARS OLD

The Cast Iron Pipe Publicity Bureau

1 Broadway **NEW YORK**

to April 10th as 150. Loss of wages $15,000. Estimated loss to the Company $40,000. This factory employs about the same number of men as the Olds Motor Works.

Chlorination Renders Water Supply Safe

Chlorination has rendered the Lansing city water supply safe for domestic purposes since April 1st. Systematic sampling several times each week was carried on until about August 1st., after which the interval between the collection of samples was considerably increased because no serious results had been found. The city has provided itself with chlorine machines and installed them at all stations except Seymour St. where the results of continued sampling justify its use without treatment. Over 800 samples of water were collected and analyzed during the course of the investigation. A chart has been prepared on the basis of these analyses showing the progress of the typhoid epidemic and the results of the tests, together with the stage of the river and record of rainfall for the entire period covered by the investigation.

Lessons from the Epidemic

The principal lesson we should learn from this epidemic is that deep wells situated in the midst of urban development require the same watchful care as would be accorded to a shallow well supply or to a surface supply known to be subject to periodical contamination, even though their depth and manner of construction would seem to preclude the necessity for such care. Assuming that such wells are constructed in the best manner possible there are still three avenues by which dangerous pollution may suddenly gain access: First, Deterioration in joints and piping. Second, Pumping in excess of the normal capacity of the wells tends to open the texture of the rock in the case of sandstone and to enlarge any fissures that may be present, and thus make the entrance of surface water seepage easier. Third, The careless abandonment of old wells penetrating the same water-bearing stratum, whether drilled for water, oil or salt, without plugging them tightly enough to exclude surface water.

It has been suggested that the State of Michigan pass a law requiring all such wells to be plugged. It is doubtful if such a law would be feasible. It might look effective on paper but it would seem that its enforcement would be attended with many difficulties.

In the construction of deep wells we certainly need a better class of workmanship than is often obtained and a thorough inspection of all that is going on during the course of the drilling for the purpose of ascertaining the exact amount of casing driven into the ground and of collecting samples of all the materials passed through during the operation. It is quite likely that in many instances double casings should be used, the first reaching down as far as it is possible to drive it into the upper layers of the rock, and the second placed inside and extending to a depth sufficient to cut off all ground water likely to be subject to pollution. A water tight packing should be placed between the bottom of the inner casing and the rock wall to accomplish this result.

The bitter experience of Lansing indicates that no matter how perfectly deep wells may be constructed and how remote their possibility of contamination may seem to be it is a matter of the greatest importance that systematic sampling be carried on with sufficient frequency to detect any possible dangerous symptoms before they reach epidemic proportions.

The foregoing paper by Maj. Rich was presented before the Sanitary Engineering Section of the American Public Health Association at its latest annual meeting.

HOW THE RADICAL LABOR ELEMENT IS BEING CONTROLLED IN SEATTLE, WASHINGTON

By F. R. Singleton, of Publicity Department, Associated Industries of Seattle

Seattle is breaking the domination over her industries of the radical element of organized labor which has held almost absolute sway in that city for the past three years, and has so restricted production and increased production costs that her ship yards, lumber mills, and many lesser industries have been finding it hard to compete with those in which the labor situation was less acute. She was beginning to lose commerce to other Pacific ports where the labor cost of handling cargoes was less. She was losing new industries seeking location on the Coast, which avoided Seattle because of industrial conditions.

Seattle Going "Open Shop"

Seeing her opportunity of becoming the greatest city on the Pacific Coast and one of the great ports of the world slipping away from her, Seattle has risen in the might of an American city, and is breaking the tightening bonds which were beginning to strangle her industries and commerce. Seattle is rapidly going "open shop." Seattle has declared her independence of organized labor rule and is refusing even to deal with the radicals in control of organized labor in the city, whose course since the signing of the armistice has proven them to be no better in their actions, sentiments and purposes than the I. W. W.

They do not call it "open shop" in Seattle. They call it the "American Plan of Employment" which, as defined by the "Associated Industries of Seattle," the organization leading the movement to success, means that every man shall be protected in his inalienable right to work, regardless of political, religious or labor affiliations; that every employer shall be protected in his right to run his own business and to hire employes without having to gain the permission of an autocrat of labor.

Public Opinion Gains Control

The open shop is being established in Seattle by the breaking of a series of strikes, designed by the radicals in the labor movement as a substitute for the general strike, by which they planned to bring about the paralysis of industry in Seattle and so discourage employers that they would be able to take over industry themselves under a soviet system. The open shop is being established by the force of public opinion as the result of an intensive campaign in the Seattle dailies, conducted by the Associated Industries. Pages on pages of advertising informed the Seattle public that the industries and commerce of Seattle were being attacked by the radicals of organized labor and that, if their domination over organized labor and the industries and commerce of Seattle were not broken,

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"Every great enterprise is but the lengthened shadow of a man." ¶ Another way to say the same thing is, "The quality of any product truly reflects the character of the men who make that product." ¶ We accept that axiom on behalf of the Reo product and of the Reo organization. ¶ Reo is one of the largest concerns in the motor car industry. ¶ But Reo has never been ambitious to be the largest. ¶ Reo never will contend for that doubtful distinction. ¶ From the very inception of this concern it has been our ambition, our purpose and our policy to build, not the most—but the best. ¶ It was resolved then that Reo never would build more motor cars than we could build and be sure that every Reo would be as good as the best Reo that ever came from these plants. ¶ To that policy we have always rigidly adhered. ¶ That we have been able to pursue this unswerving course was due mainly to the fact that while there are several thousand shareholders in Reo, the control was, from the first, and still is, held by the actual directing heads of the business. ¶ These men are not absentee directors—every one of them is at his desk every working day of the year. ¶ In your dealings with Reo—whether as a distributor, a dealer, a salesman or a user—you may feel always that you are in direct personal contact with these men—each in the department over which he presides. ¶ This is a condition almost unique in big business organizations today. ¶ May we not assume that the quality of the Reo product is as different from the ordinary as is that Reo policy—that Reo organization? ¶ We are frank to say we do think so. ¶ We believe that the uniformity of excellence of the Reo product is the direct and the logical result of that close personal interest and supervision of the directing heads of Reo. ¶ Your approval of the Reo product—expressed in the over-demand Reo motor cars and "Speed Wagons" have always enjoyed—encourages us to believe that you fully approve that policy. ¶ Not the most, but the best—the precept crystallized in the product—the ideal practically applied. ¶ In the beginning of this, the seventeenth year of Reo, we thank you most heartily for your patronage in the past; and we assure you that, since the same executives will continue to control Reo, the same policy will obtain.

Reo Motor Car Company
Lansing, Michigan

the population, industry, commerce and prosperity of the city would decline.

Americanism in Industry

The response was prompt. The Chamber of Commerce, the Rotary Club, the Kiwanis Club and all other civic and commercial organizations of the city took action demanding the end of radicalism and sabotage in Seattle, and endorsing the open shop in industry. These declarations were published in page advertisements, and at the end of ten days of this intensive advertising, the public sentiment in Seattle was overwhelmingly in favor of Americanism in industry, and the power of the radicals was broken. Where, a year ago, the closed shop was strongly supported by public opinion in Seattle, today the public is demanding open shop, and any employer who signs a closed shop agreement with any labor union will be exceedingly unpopular.

Movement Not Against Unionism

The movement in Seattle is not against unionism, but against the domination of unionism and industry by un-American radicals. The Associated Industries, in its publicity, has repeatedly recognized the right of workers, as well as employers, to organize; has endorsed the principle of collective bargaining; has declared that there shall be no discrimination against union men under the American Plan, and has urged employers not to take advantage of unemployment to cut wages. The Associated Industries has been consistently American and so has won the confidence of the public and of the conservatives of union labor.

Loyal Workers Declare Independence of Radicals

Seattle is winning industrial independence by the power of organization. While the individual employer, with a few exceptions, in the past has been unable to withstand the radicals who ruled Seattle labor and has bowed to their dictates, the employers of Seattle collectively, banded together along with many other citizens in the Associated Industries, have been able to defy the radicals and to establish open shop in every Seattle industry in which a strike has occurred or a contract broken by the unions, during the past three months. In rapid succession, the building industry, the job printing industry, the merchant tailors, the dyers and cleaners, the jewelers, the shoe repair shops and the master piledrivers have declared and established their independence of radical domination, meaning that the unions have lost control of industries in which thousands of men and women are employed.

Existing Contracts with Labor Respected

Seattle would progress on the open shop road much more rapidly, under the stimulus of public opinion, if it were not for the fact that the Associated Industries has taken a strong stand against the breaking of existing contracts with labor unions. One of the cardinal principles of the organization is that employers must keep faith with each other and with employes, and so the open shop movement progresses as strikes occur, unions break contracts and existing contracts expire.

General Strike Starts It All

The Associated Industries was formed in Seattle as a result of the general strike of last February. The revolutionary character of that attempt was recognized by the public and the necessity of cleaning the radicals out of organized labor was brought home. There was much open shop sentiment as a result of the general strike but, as a large percentage of union labor in Seattle is loyal American, the majority of employers favored giving the unions a chance to clean house of the radicals before taking any drastic steps. The Associated Industries, led by Frank Waterhouse, a leading citizen of Seattle, with large shipping and industrial interests, was organized to band all employers together in an effort to bridge the chasm between the employers and employes by giving the employes such a square deal that the revolutionary appeals of the radicals would fall upon deaf ears, and that labor would throw the I. W. W. and other radicals out of control of Seattle unions. During last spring and summer, the Associated Industries grew rapidly in membership and influence, and endeavored consistently to cultivate better relations between employers and labor, and to promote a square deal for the employe, the employer and the public in general in Seattle—but the unions failed to clean house.

Impossible Wage Demands

The final declaration for the open shop in Seattle came when Mr. Waterhouse became convinced that the radicals still in complete domination of the unions, were attempting, by a series of strikes, to paralyze the industries of Seattle and take them over. Advance information of this plan was verified by events. On Sept. 2, the carpenters and some of the other unions in the building trades struck to enforce impossible wage demands, in spite of the vital public need of more homes and other buildings and the willingness of the employers to arbitrate. They arrogantly stated that their demands involving $10 a day wage for carpenters and other exorbitant increases, must be granted first, and then they would talk arbitration. The job printers, the tailors, the dyers and cleaners and piledrivers followed in rapid succession and the air was full of talk of strikes in other industries.

On October 14, Seattle contractors, backed by the Associated Industries of Seattle, declared open shop in the building industry, after six weeks of fruitless negotiations with the unions to bring the strike to a settlement on terms which would not make it impossible for new buildings to be undertaken. Their action, announced in page advertisements in the daily newspapers, was applauded by the public. On October 31, the Building Trades Council voted to call the strike off. The strikers returned at their old wages and under open shop conditions.

It took only one seven-column, fifteen inch advertisement in the Seattle dailies, announcing open shop and inviting men to work under the American Plan, to establish the piledriving industry on the open shop basis. The fight has been harder with the job printers, the tailors and the dyers and cleaners, but the employers in each of these three industries declared unequivocally for the open shop and are making it stick. The employing printers have been drawing men from all over the United States to take the place of those strikers who refuse to return to work, and are gradually building their forces up to normal. The tailors have been greatly helped by the fact that all the associations of employing tailors in the cities of the Pacific Coast, as far south as San Diego, California, have followed the example of Seattle and have declared open

shop. The dyers and cleaners have gotten back many of their old employes and are back to normal in their operations. To have granted the demands made in any of these lines would have amounted practically to turning over the business to the employes.

Unions Turn Against Strikes

The declaration of open shop by the building contractors was a body blow to union labor radicals and disarranged their plans to bring about industrial paralysis by involving one industry after another in strikes. A sentiment against strikes developed in the unions, and no more strikes were called.

Once decided for the open shop, the Associated Industries conducted an intensive publicity campaign in the three loyal daily newspapers of Seattle. In a series of ten page advertisements, beginning October 29, the Associated Industries aroused the community to the danger of radical domination and demanded that the industries of Seattle be run on the American Plan. The campaign was assisted greatly by the newspapers themselves in strong editorial and news publicity.

At the end of ten days, public sentiment was strongly in favor of the open shop.

Then came the murder of four former soldiers by the I. W. W. during the Armistice celebration parade at Centralia, Washington, a few miles from Seattle and the suppression by the government of the disloyal Union Record, the organ of the radicals to crystallize sentiment in Seattle against the Reds in control of labor. The sentiment grew so strong that the elimination of the radical alone can save unionism in Seattle.

Movement Spreads to Other Coast Cities

The movement for the American Plan, the open shop, has spread from Seattle to the other cities of the Pacific Coast, and the Pacific Coast expects to see it sweep the country until the right of all Americans to work without being subjected to coercion and intimidation is established. San Francisco, Portland, Spokane and Tacoma have organized "Associated Industries" on the Seattle plan. The Pacific Coast is making a new declaration of independence for America.

FLUSHING AND CLEANING WATER MAINS

By William Molis, Superintendent of Water Works, Muscatine, Ia.

Our way of flushing and cleaning water mains at Muscatine, Ia., is to gate off a main on both sides, say for a half mile or a few blocks at one flushing. We start at some high point in the system, either by opening hydrants or a flush gate if we have them. If no flush gate is available, then we start at the high point by opening hydrants down the line until we get to the end. This same procedure must be taken in the cross sections, the same as for main lines, said Mr. Molis in addressing the Iowa Section of the American Water Works Association.

This flushing process is mostly done at night, when it will inconvenience the least number of people. In the

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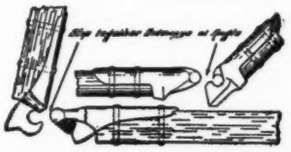

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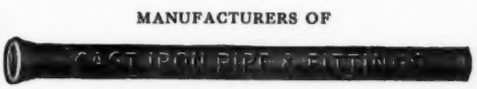

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outlying districts we usually flush mains in the day time. We must have a good force of men on the job to be ready to answer a fire alarm to open up our gates quickly.

Flushing a 16-in. main or larger is not an easy task; we have to open a good number of hydrants to do the work right. Where we have a streamer connection on our hydrants by opening these we get a good flow and it is easier on the pavements.

We have two flush gates in our system, one with a 6-in. and the other an 8-in. opening, which opens into a large sewer or creek. I would not advise emptying into a sewer that is too small, as this causes all kinds of trouble by overflowing into cellars.

If you have much deposit to wash out, you will surely have some trouble with your meters, which have to be cleaned out after flushing.

EXPERIENCE WITH A BROKEN 24-IN. WATER MAIN

By S. L. Etnyre, Superintendent of Water Works, Council Bluffs, Iowa

Before describing our recent experience with the blow-up of a 24 in. water main, I will briefly describe its history and its importance in the operation of the plant, said Mr. Etnyre, in addressing the Iowa Section of the American Water Works Association.

This main was laid on Broadway, in the year 1882, running from the Broadway Pumping Station at 37th street to 21st street, a distance of 8,500 ft.; from this point to 8th street is 5,323 ft. of 20 in, thence to the high level storage reservoirs, 5,200 ft. of 16 in. Up to 1915 all the water for the city was supplied through this 24 in. pipe. On account of the importance of this main, and owing to the fact that with increased consumption the pressure materially increased, it was found necessary to lay an auxiliary 16 in. main from the Broadway Station to 21st street, and this was completed in 1915. With the reservoirs' storage it was calculated that the 16 in. would supply the city in the case of any mishap to the 24 in. Two 24 in. valves were cut in the Broadway main and a drain laid into the sewer from the main at its lowest point.

In 1884 the Broadway main broke at 30th street, a section 12x24 ins. blowing out at the bottom. No flaws were noticeable. In 1908 this main broke at 28th street, a triangular section 18 ins. at the base and 6 ft. long blew out at the side. No flaws were noticeable. In 1909 on the west side of 34th street the pipe broke as if pulled apart. No flaws were noticeable.

The normal pressure carried by this pipe was 105 lbs. On October 6, 1919, our last break took place on the east side of 34th street, a 12 ft. section splitting on its side its entire length. A Crosby pressure chart taken at the pumping station showed that the pressure dropped suddenly from 125 lbs. to 17 lbs. The volume of water escaping through this break was enormous, resulting in the drop of pressure all over the city, and many parts even at moderate elevations were without water until the valves were closed. From measurements taken at the high level reservoir, making allowance for the normal city consumption, over 1,000,000 gals. had run out through this break. Fortunately, however, there was no material damage to private property.

The chart also plainly showed the time of closing the valves. Some time was lost in this work by the breaking of a 24 in. valve stem. Pumping to the city through the 16 in. main was started immediately upon the closing of the valves. The drain valves into the sewer were then opened, and when the pipe was broken into it was found to be entirely free of water. It is also remarkable that all valves proved to be water tight. The defective section was broken up with sledges, and replaced with a new length and the main ready for service within 15 hours from the closing of the valves. During the time the repairs were being made less than 1% of the consumers of the city were without water, and but for the breaking of the valve stem above referred to less than one-half of the 1% would have been without water.

From examination of a small piece of the pipe along the line of fracture, it was noticed that the original casting is well preserved and that at one point some of it shows on the fractured surface, indicating a casting defect at this point.

A careful examination of the fracture, however, does not warrant the assumption that this condition prevailed to any extent. The thickness of the shell along this line was a good average with the rest of the pipe, being approximately 1 in. The question that now naturally suggests itself is: "What is the reason for this break?" Of course, the water pressure was partly responsible, but is not the complete answer. We know by looking at the pressure chart it was not caused by "water hammer." The thickness of the shell seems adequate for the pressure it has to carry; it is a good grade of metal and there is no evidence of serious flaws on the fracture line or elsewhere when broken into small pieces.

TEARING DOWN A BRICK SMOKE STACK

Disposing of an old brick smoke stack by the usual method is a slow and costly procedure. Scaffolding has to be built and workmen begin at the top removing the bricks one by one with a mortar pick.

A stack stood at the plant of the Cadillac Motor Company, Detroit, Michigan. It was 125 ft. high and built round on a hexagonal base. It was desired to remove the chimney quickly so that rebuilding on the site could be promptly gotten under way. It was decided to blast it down with dynamite as surrounding buildings had already been torn down and no damage was to be feared.

Ten holes were drilled in three faces of the hexagonal base. They were made about 18 in. deep and 3 ft. apart. All holes were on the same side of the stack—the side toward which it was desired to have the stack fall in case it should fall at full length on the ground.

Two and a half pounds of dynamite were loaded in each hole and well tamped in with moist clay. Electric blasting caps were used so as to get an instantaneous shot. In all 25 lbs. of 40 per cent. dynamite were used.

The shot was a success from every standpoint. The result was that the stack merely crumbled on its base, the blast having shot its support out from under it. No bricks were scattered beyond 20 ft. from the base. Even if

buildings had been very near, no damage would have resulted.

The fall broke up the chimney into sections small enough to be handled by one or two men, although comparatively few of the bricks were broken except immediately contiguous to the blasts.

It required less than two hours to tear down the stack and but a few additional hours to clear away the bricks and mortar so that building operations could be commenced on the site.

MORE ATTENTION TO HUMAN SIDE OF MUNICIPAL ENGINEERING

Presidential Address of E. R. Conant at Annual Convention of American Society for Municipal Improvements.

Let us consider not only the technical, but also to a greater degree than heretofore, the human side of municipal engineering and endeavor to start a movement that will stimulate the interest of engineers, and especially of municipal engineers along social and economic lines. That the engineer's position before the public may be strengthened by dealing with the human side of the engineering question is illustrated by the recent results obtained by the American Association of Engineers, a comparatively new organization. In that association the engineers are united in a single purpose, and by their intensive co-operation there is better opportunity for properly dealing with communities through representatives from their organization, urging thtir cause and exerting their influence in order to obtain recognition.

Engineering Articles in Popular Mediums.

While it is very well to create a good feeling between us, to maintain a high standard of ethical honor, yet the engineer must become more closely identified with public and political affairs. He must exert his influence in his community by appearing at public assemblies and by taking part in public gatherings when the interests of the community are at stake. He should not alone be satisfied with preparing technical articles for exchange among his brother engineers, but, in the writer's opinion, the confidence of the public in general in the engineer would be promoted if he would prepare articles involving engineering practices and discussions of interesting engineering works, for magazines that have a wide circulation. If these articles, prepared by the engineer, were disseminated before the public in terms not too technical, it would be one means of educating the public to the value of the engineer. We note that during the war much appeared in the press concerning the engineer's part upon the battle-field and in war industries work, and why, in peace, should this not be kept up?

Licensing

The writer advocates the promotion and protection of the professional engineer, as well as the protection of the public, through a licensing system under state control, whereby the engineer must qualify for every special class of engineering covered by his license. Iu certain states this is being done, and we can go to far away Africa to observe an example as regards the recognition of the professional engineer, as the majority of the general superintendents and assistants operating the railroads and harbors, as well as all land surveyors, are licensed before they can be employed.

Better Compensation

The reconstruction period is wrought with perils only labor and tradesmen obtain. The relation between employer and employe must be determined upon the basis of fair play and good will. Engineering organizations should consider and participate in working out plans whereby the conditions of a large body of engineers and allied professional men can be ameliorated. We must coordinate our efforts and lay out a definite plan of activities.

One of the organizations that is advancing the status of the municipal engineer is the City Managers' Association. The growth of this recent organization shows that the recognition of the engineer is increasing. Of late years the city manager plan has received an impetus and, in many respects, it appears to have advantages over any other plan before tried. The City Managers' Association and our organization encourage a form of municipal management that promotes efficiency and economy, and the two associations should co-ordinate their efforts.

Improving the Conditions of the Municipal Engineer

Let us deal, for the moment, with the municipal engineer, and discuss how his condition can be improved. We have referred to the city manager plan, but this plan must originate in a community by the public, but at the same time, the engineer can be instrumental in initiating and furthering the movement, whereby the public

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may be educated to the plan. The engineer, to improve his condition, should be interested in economic and social problems that arise in his community. What a small per cent. of engineers are willing, or are capable, of taking part in discussions at public meetings? How very few furnish articles to the press dealing with the work that they are engaged upon or, outside of this, touching upon problems that mean so much to a community? Engineering articles that would be laid before the taxpayer must be given in a lucid and not too technical manner. At this time they are needed to off-set a large amount of literature that is distributed for the purpose of aiding commercialism and which often misleads the public. The engineer should be able to combat detrimental influences and should have the character and stamina to fight his case, and endeavor to make the public understand and realize that the engineering profession is as important as the profession of law or medicine. The value of information and advice to the public is largely based upon its source. The best corporation lawyer in the world could not give as sound engineering advice as the average technical engineer. The honest politician attempts to mould the public mind for the public's good, but he cannot be considered competent to speak intelligently on engineering matters or policies. The engineer of today, to improve his status, should not confine his activities to as great an extent upon technical problems as in the past.

The best interests of all engineers, and especially of municipal engineers, are furthered by their becoming identified with organizations such as ours, the American Association of Engineers, the City Managers' Association, and perhaps others.

Engineers Should Be More Independent

Some states are forming independent societies composed of municipal engineers and allied professional employes. If competent engineers would only accept municipal positions where politics did not enter to such an extent as to cripple their engineering activities and work, and who, when petty political activities did enter, would acquaint the public with the true conditions, and then, if necessary, resign, the time would speedily come when better conditions would exist. It is unfortunate that there are so many engineers who are willing to act and serve under the power and dictates of the politician. A licensing system properly conducted, co-ordinating with state societies of municipal engineers, would, to a considerable degree, bar many incompetent men who call themselves engineers from obtaining municipal situations that should be filled only by the competent engineer.

Assuming the city engineer to be competent and that he remains so, and providing his tenure of office is to extend over the period that permits of improvements being made from funds that are available during his employ, there would be a great incentive for him to plan work for the future, to store up valuable information, and if he plans his projects in a proper manner, to become a great benefit to the community.

The average layman, and especially the politician, either intentionally or unintentionally, usually do not understand the work and study of the engineer. They too often gauge his value by the amount of detail work he does, when actually, if he is a good administrative officer, he places this work upon his subordinates. The municipal engineer should be permitted to take part in the making up of budgets. In fact, he should almost be considered one of the administrative officers, to solve problems, even if a portion of the work digresses somewhat from strictly technical lines. He should become acquainted with laws and ordinances, and gain the good will of the legal department.

It is unfortunate that there is not a more general realization of the importance of designing and planning work by the municipal engineer. This requires experience, skill and ability. The non-technical man is less capable of performing these functions than of looking after merely the construction and maintenance work. Information that comes to us indicates that the position and standing of the municipal engineer is improved, that the percentage of engineers employed by municipalities is greater than heretofore who are competent to plan work, who work upon their own initiative, and who refuse to be controlled by the political branch of the city administration.

Let us wake up to the fact that holding close communion among ourselves is very well in one sense, yet it does not awaken the layman and public officers to the value of the engineer; therefore, let us resolve to go outside of the camp and employ proper, ethical methods of educating the public to the value of the engineer's services.

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Ark., Morrilton—Lewellyn & Co., awarded contract for constructing 33 miles of road, at $350,000.

Ark., Sheridan—H. W. Kaylor, Hagerstown, Md., awarded contract to construct 8 miles grading; ⅛ mi. bitum. macadam paving; culverts, etc., at $47,200.

Ark., Star City—Echols & Helton, Star City, awarded contract by Lincoln County Commrs., to construct 19 miles gravel road; $85,000 available.

Cal., Long Beach—Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, award. contr. for paving 15th Pl.,—Ocean Blvd. to 175 ft. south—at 30c sq. ft. for 4-lb. asph. macadam paving, including grading 60c lin. ft. curb; 30c lin. ft. cem. walk and culvts. complete $50.

Cal., Los Angeles—A. Teichert & Son, Sacramento, award. contract for paving alley in Block 86 at 4.5c sq. ft. for grading; 14.2c sq. ft. for 4-in. concrete paving; also 20c lin. ft. for curb; in city of Merced, Cal.; Geo. H. Oswald, 405 O. T. Johnson Bldg., Los A., award. contract for paving Washington St.—Arlington to west city boundary—Los Angeles, at $92,228,38.

Cal., Los Angeles—Wm. Liddington, 420 E. 60th St., award. contr. at $3,596 for shaping rdbed, construct'g. cem. walks, curbs, and conc. gutters in Rd. Impvt. Dist. No. 143 at 87th & Moneta Ave.; Fleming Constr. Co., Pomona, award. contract for paving with conc. 1.01 miles roadway on Cypress Ave., near Covina, Rd. Impvt. Dist. No. 142, at $14,500.

Cal., Modesto—Standard Paving Co., award. contr. for paving H Street—2nd St. to city limits; $12,448; also conrtact for paving Modesto Ave.—McHenry to Johnson Sts.—at $5,000.

Cal., Red Bluff—M. E. Edwards, award. contr. for spreading crush. gravel on Manton Rd., at $1.50 a cu. yd. for distance of 7 miles.

Cal. Sacramento—Lynn S. Atkinson, Jr., Sacramento, awarded contr. by State Hwy. Dept. for constr. of sect. of hwy. betw. 2 mi. north of Vina and Los Molinos—abt. 4.5 miles, at $53,489. State will furnish reinforcing steel, culvt. pipe, cement, sand and coarse rock to value of $36,991, making total cost of the work $90,481.

Cal., Sacramento—Following contracts awarded by State Hwy. Comn.; H. H. Lienau, Redlands, grading 7.1 miles in San Fernardino and Riverside Cos. betw. Co. Hwy. No. 32 and Beaumont; $63,622; Geo. R. Curtis, 2440 E. 26th St., Los Angeles, paving with conc. 5.2 miles in Ventura Co., betw. southern boundary and Conejo grade, at $114,250; Lynn S. Atkinson, Jr., Sacramento, grading & paving with conc. 5.5 miles in Tehama Co. betw. 2 mi. no. of Vina and Los Molinos, at $53,385.

Cal., San Bernardino—W. D. Bohan, awarded contracts for paving Hope St. betw. Baptist alley and Second St., at $1,531; Second St., betw. I and Carter Ave., $4,925; Base Line St.,—Arrowhead Ave. to B St., at $3,521.

Cal., San Francisco—Fay Improvement Co., awarded contract for grading and paving Avenues 27 to 24 betw. Taraval and Ulloa streets, at $64,774.

Cal., Santa Ana—Wells & Bressler, Santa Ana, award. contr. for grading 3.6 miles County Park Rd., at $29,238; also contr. for paving E. 4th St., and Tustin Ave., at $10,009.

Cal., Santa Barbara—A. L. Pendola, Santa Barbara, awarded contract to grade abt. 2 miles of road leading from Sheffield Reservoir across Mountain Drive to Rattlesnake canyon rd. for the Cielito Co. Road will be paved as soon as the earth has settled; Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, award. contract for paving portions of Third Ave., Third St., Nogales Ave. and Bath St., at 25.4c sq. ft., for 4-in. conc. base with 1½-in. Warrenite surface including grading; 25.4c sq. ft. for 5½-in. Warrenite; $1.35 lin. ft. comb. cement curb & gutter; 60c lin. ft. cement curb; 25c sq. ft. cem. gutter; $60 for 6-in lateral sewer.

Cal., Santa Barbara—Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, awarded contract for paving portions of Santa Barbara, Arrellaga Sts., with 4-in. conc. base and 1½-in. Warrenite surf. and 5½-in Warrenite and constructing cem. curb and gutter, conc. drives and 6-in. sewer connections, etc., at $10,771.

Cal., Santa Monica—The J. D. Kneen Contracting Co., Dudley Block, Santa Monica, awarded contract for impvt. of Palisades Ave. and Adelaide Dr., also portions of Montana, Alta, Marguerita and Georgina Aves., at $180,239.

Cal., Santa Rosa—County Engr. Lloyd Aldrich instructed to proceed with constr. of certain units of new Sonoma Co. Hwy. system by day labor. The units for which the engineer will secure labor and materials and proceed at once with constr. are on Petaluma-Valley Ford Rd. starting at Petaluma end; Petaluma-Sonoma Rd., starting at Petaluma end and Healdsburg to Napa Co. line rd., thru Knights Valley.

Cal., Stockton—Cy Moreing, awarded contract for conc. macadamizing the new Borden Road over Victoria Island—Middle River to Old River—at about $25,696, for a distance of about 4½ miles.

Cal., Ventura—Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, awarded contract for paving with Warrenite and concrete, Santa Clara, Ash and California Sts.

Cal., Visalia—Federal Construction Co., awarded contract to pave abt. 2½ miles of city streets with asph. concrete base and bithu. and Topeka surfaces, at $157,000.

Conn., Hartford—State Highway Comn. let contract for improving 3,800 ft. Bozrah St., 3-in. trap-rock surface over 5-in. gravel base, Bozrah Twp., to J. Arborio, 80 Park St., New Haven, at $18,000; 3,890 ft. Middlefield Rd., 3-in. trap rock macadam, Middletown Twp. to A. Brazos & Sons, Oak St., Middletown, $15,000; 802 lin. ft. Forest St., bitum. macad. New Haven, to C. W. Blakeslee & Son, 58 Waverly St., New Haven, at $41,000.

Ga., Amercus—Prayter, Howton & Wood Constr. Co., Birmingham, Ala., award. contract to surface 3 miles Andersonville Rd. with concrete; Fed-aid Project No. 101; 31,880 sq. yds. paving, at $95,472.

Ga. Augusta—Council awarded following contracts: Ely Constr. Co., to pave Greene St., Telfair St., 10th, 11th Sts.—Tetnall to Broad—with asphalt, at $165,000; Lawrence Constr. Co., to pave 11th St.,—Broad to Fenwick Sts., with concrete, at $25,000.

Ga. Lagrange—D. R. Cook & Co., Montgomery, Ala., awarded contract to grade 15 miles of road betw. here and Cowetta County line, at $95,498.

Ida., Kellogg—Jno. Nordquist, Wallace, awarded contract for constr. of .96 miles of Pacific Hwy.,—Moon creek to Van Gilder's ranch, at $63,609.

Ida., Twin Falls—Warren Construction Co., Portland, Oregon, awarded contract by City Council for 12 miles of bithulithic paving in city, at $733,627.

Ill., Carlyle—Jno. Marsh, Inc., Chicago, awarded contract by Rd. & Bridge Comm. of Board of Supvrs. St. Clair County, for conc. rdway—E. St. Louis to Granite City—abt. 12 miles, at $23,934.

Ill., Chicago — Following contractors awarded contracts for 6-ft. cement walks in various sections of city: Siewert-Callsen Co., Warrant Nos. 28592, 28166, 28602, 28607; G. Kehl & Son Co., 28379, 28284, 28311; Sompson Construction Co., 28492, 28173, 28509, 28449; West Englewood Construction and Supply Co., 28608 (system of streets).

Ill., Joliet—Powers-Thompson Constr. Co., Joliet, awarded contract for bldg. 3 sections of the Illini trail thru Will and Grundy Cos., at $647,572.

Ill., Quincy—Walter Bangert, awarded contract for county road improvement—about 40 miles.

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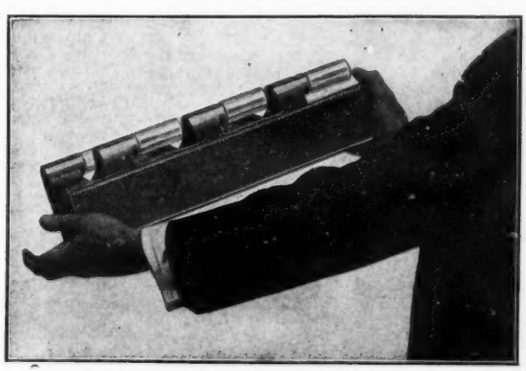

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Ill., Springfield—The C. E. Carson Co., Chicago, awarded contract for constructing sections I and U, La Salle Co., at $169,568.

Ill., Springfield—Keokuk Quarry & Constr. Co., Keokuk, lowest bidder and will be awarded contract for constructing, etc., S of Springfield-E. St. Louis Hwy., Macoupin Co., at $159,760.

Ind., Anderson—Lee McTurnan and Jno. A. Jones, awarded contract for bldg. two miles each of crushed stone road on line betw. Madison and Grant Counties, at $44,200.

Ind., Plymouth—Indiana Constr. Co., Logansport, awarded contract for constructing Behmer Rd.; also Matchett Rd. No. 1 and No. 2, at $337,000; Newman Bros., Culver City, Ind., awarded contract for Kaley Rd., at $12,900.

Ind., Warsaw—Contracts for construction of 9 roads in various sections of Kosciusko County awarded at total cost of $317,284, as follows: E. J. Cooper Rd., Van Buren Twp., 2½ mi. long, to A. A. Cast & Son, Warsaw, at $47,895; Geo. Harlan Rd., Scott Twp., 2 mi., to McClintic, Colwell & Gordy, Syracuse, at $34,886; Lewis B. Mendel Rd., Seward Twp., 2¼ mi., to E. A. Gast, at $49,690; Sylvester Essig Rd., Plain Twp., 3 mi., to Cast & Son, Warsaw, at $65,485; Lawrence Lozier Rd., 2½ mi., Central Constr. Co., Logansport, low bidder at $18,800; L. A. Siders Rd., 4 roads near Syracuse in Turkey Crk. Twp., included under this contract. McClintic, Colwell & Gordy, Syracuse, only bidders, at $16,566,, $33,100, $35,228 and $15,632, respectively.

Ia., Cedar Rapids—Wilhelm Constr. Co., Cedar Rapids, award. contr. for 61.22 miles conc., one-course paving in Phillips Co., Ark. Portion of this conc. work will be sublet.

Ia., Denison—Deloit Bridge Co., awarded contract by Harrison Co., for grading, at $69,000; also contr. for cement culverts and iron brdgs. on Lincoln Hwy., at $74,000.

Kans., Arkansas City—Stanton Construction Co., Leavenworth, awarded contract for paving, grading and curbing here at $338,500.

Kans., Fort Scott—J. T. Dalton & Son, Junction City, Kans., awarded contract for constructing 5.91 miles bitum. macadam with drainage structs., and auxiliary construction, complete at $139,678.

Kans., Kansas City—G. G. Roudebush, awarded contract for repaving Central Ave., on Kansas side of Park Ave., to 18th St., at $111,484.

Mass., Boston—Contract for road in Lanesboro, awarded to D. J. Walsh, Pittsfield, at $40,078; contr. for abt. 5.300 ft. asph. road in Wareham, to Wm. A. Jones, Barnstable, at $17,896; W. F. Loud & Sons, Quincy, contract for 9.900 ft. road in Norwell, awarded at $21,003.

Mass., Boston—Coleman Bros., awarded contract for recut granite block pavement in Rutherford Ave.—Cambridge St. to Chapman St., at $62,819; Jos. Meltzer & Co., contr. for constructing concrete walks on Boston Common, at $3,922.

Mass., Boston—Antony Cefalo, award. contr. for rough grading in Centre St.,—South to Spring Sts.. West Roxbury, at $9.875; B. E. Grant Co., contr. for sheet asph. pavement in Tremont St.,—Dover to Northampton Sts.,—at $99.034; Martino De Matteo, contr. for Topeka pavement in Hyde Park Ave.,—Metropolitan Ave. to River St., Hyde Park—at $124 585.

Mich., Bessemer—Maki & Mansi, Mchelli & Contralto, awarded contract for grading and graveling Ironwood County-Lake Superior Hwy., abt. 12 miles, at $20.200.

Mich., Crystal Falls—Holmes & Burridge, Crystal Falls, awarded contract for Rd. 12, Iron River & Stambaugh Twp., 4 miles, 15 ft. wide, at $25,300.

Mich., Lansing—Following contracts let for hwy. construction: Freeman Lumber Co., Engadine, Rd. No. 12-20, Mackinac Co., 4.223 mi., at $50.208; A. Mitchell, Boyne City, Rd. 13-11B, Melrose Co., 3.407 mi., at $21.373.

Mich., Lansing — Following contracts awarded for Michigan state trunk line work: Cheboygan Co., Inverness-Mullett Twp., B-gravel, 6.887 mi., to Cheboygan Co. Commrs., Cheboygan, at $84,034; Midland Co., Homer-Lee Twp., grading, drainage structs., etc., 1 mile to L. P. Larsen, Midland, at $8.832; Oscoda Co., Big Crk. Twp., B-gravel, 0.994 miles to Oscoda Co. Comrs., Mio, at $13,176.

Mich., Lansing—Following contracts for state trunk line highways awarded by State Highway Department: Presque Isle Co., Rogers Twp., B-gravel 2.910 miles, to L. W. Edison, Rogers, at $37,573; Van Buren Co., South Haven City, F-concrete, 0.154 miles, to Marsman & Green, Grand Rapids, at $4,736; Otsego Co., Bagley, Otsego, B-gravel 7.573 miles, to Midland Construction Co., Midland, at $110,478; Crawford Co., Grayling, Frederic, C-stone gravel, 7.651 miles, to Crawford Co. Commrs., Grayling, at $109,918; Houghton Co., Adams, Frederic, E-bit. macadam, 2.727 miles, to Smith-Sparks Constr. Co., Houghton, at $31,437; Houghton Co., 2.707 miles, to J. E. Nicholas, Marenisco, at $25,265—total 262.308 miles, $3,161,103.07.

Mich., Royal Oak—Calvert Co., Detroit, awarded contract for 3 miles of 9-ft. gravel road from Twelve Mile Rd., Royal Oak east to the Macomb county line, at $41,705.

Minn., Duluth—Bartlett-Ostelhoult Co., Duluth, awarded contract for grubbing, clearing and ditching State Rd. No. 4, 17 miles from jct. with Normanna Rd., at $29,321.

Miss., Canton—Will Owens Co., Jackson, Miss.; Healy Constr. Co., Meridian, Miss.; J. N. McLeod, Jackson, Miss., awarded contract for 20 mi. gravel road at $258,000.

Miss., Tunica—M. E. Larkin, awarded contract to construct 41 miles of gravel road, at $160,000.

Mont., Forsyth—Lindgren, Peterson & Thornton, award. contract by Rosebud County, for Fed. Aid Proj. No. 15, at $186,806.

Neb., Omaha—H. Murphy Constr. Co., 204 Karbach Blk., awarded contr. for paving 6 blks. 60th St., asph. conc. on 6-in. conc. base, at $17,754; portion of 58th St., 2-in. asph. conc. on 5-in. conc. base, at $13,491; also Curtis Ave., same material, at $17,906. Included in the contracts are curbs, gutters and excavating.

Nev., Carson City—H. Francisco, Laws, Cal., awarded contract to build 6 miles graveled road, 15 ft. wide, south of Yerington, at $44,717; W. J. Schmidt, Berkeley, Cal., awarded contract for the Fallon Sink job, embracing constr. of road from a point one and three-tenths miles east of Salt Wells to Sand Springs—about 10.5 miles—at $67,950.

N. J., Cape May—Sutton & Corson Co., Ocean City, awarded contract to pave with concrete Perry street, Jackson Street and portions of Ocean and Decatur Sts., at $58,000.

N. Y., Buffalo—H. P. Burgard Co., 1968 Gillmore Ave., awarded contracts for paving 4957 yds. River St., dressed blk. 6-in. conc. base, Medina sandst. curbing, at $32,220; 4621 sq. yds. Elmer St., stand. asph. on 6-in. conc. base, Medina sandst. curb'g. at $23,530; 2426 sq. yds. Page St., stand. asph., 6-in. conc. base, Med. sandst. curb, at $13,650; 607 sq. yds. Lathrop St., stand. asph. conc. base, at $32,870; 3504 sq. yds. Fay St., stand. asph. conc. base, Med. sandst. curb, at $17,230; Rock Asph. & Constr. Co., Morgan Bldg., contr. for 5400 sq. yds. Ohio St., stand. asph., Med. Sandst. curb, at $27,050; 10,847 sq. yds. S. Park Ave. stand. asph. at $51,641, etc., etc.

N. C., Goldsboro—West Constr. Co., Volunteer Life Bldg., Chattanooga, Tenn., awarded contract for 7 miles sheet asph. paving and 2,600 lin. ft. conc. curb and gutter, at about $300,000.

N. C., Jefferson—Callahan Construction Co., Knoxville, Tenn., awarded contract to grade and drain 40 miles of road in Ashe County; $650,000 available.

N. C., Salisbury—R. M. Hudson Co., Atlanta, Ga., awarded contract to construct 23,500 sq. yds. bithu. on conc.-base paving, at $242,000.

O., Sandusky—Land & Hodges, award. contract to construct 4½ miles of trunk line road, at $59,301.

O., Toledo—M. Rabbit & Sons Co., Toledo, awarded contract for Summitt St. extension and divergence of Swan Crk., at $496,530.

O., Youngstown — Seiple-Wolfe Constr. Co., local, award. contract for improving sect. D. I., C. H. No. 70—about 1.38 miles near Mineral City, at $60,048.

Okla., Edmond—H. F. Struble, Norman, awarded contract to pave streets here, at $230,449.

Okla., Okla. City—Western Paving Co., awarded contract for paving Olive Ave.,—20th to 23rd Sts.,—at $9,763; also contract for paving on Douglas and Elison Aves.,—17th to 21st Sts.—at $60,269 and on Geary Ave.,—4th to 8th Sts., at $14,423.

Okla., Tulsa—Parker-Washington Paving Co., awarded contracts for paving 4 streets, at $34,798.

Okla., Tulsa — Standard Paving Co., awarded contract to construct 120,000 sq. yds. asph. conc. paving. $600,000 available.

Ore., Baker—F. C. Oxman, Baker, awarded contract for graveling 7.8 mi. of road on Baker-Middle Bridge sect. of Baker-Cornucopia post road, at $38,000.

Pa., Harrisburg—MacArthur Bros. Co., New York City, awarded contract for bldg. 42,232 ft. one-course rein. conc. and Hillside vitr. brk. rdway. on State Hwy. Route 317—Berlin, Somerset Co., to Johnstown, Cambria Co., at $470,098.

Pa., Harrisburg—B. G. Coon Constr. Co., Luzerne, awarded contract for constr. of 26,215 ft. state hwy., in Wilmot and Terry Twps., Bradford Co., at $236,345; Cumberland Contracting Co., Cumberland, Md., 20,109 ft. grading and drainage betw. Myersdale and Garrett, Somerset Co., at $129,524.

Pa., Harrisburg—Following contracts let for road construction: Philadelphia Paving Co., Philadelphia, contr. for bldg. sect. of state-aid road, approx. 27,633 ft long—Douglasville to Yellow House, Berks Co.—at $60,423. Specfs. call for bitum. mixt. on prepared broken stone base; Benjamin Foster Co., Philadelphia, contr. for that portion of Route 150 extend'g. from Tullytown to Morrsville and calls for 20,902 ft. rein. conc. rdway., at $144,085; T. H. Gill Co., Binghamton, N. Y., contr. to build 19,215 ft. rein. conc. rdway. on Route 15, Wysox and Rome Twps., Bradford Co., at $150,668; E. M. Love & Son, Corry, Pa., contr. for constr. of rdway. on Route 304—Northeast Boro., Erie Co., at $72,523.

S. C., Camden—Chitwood & Palmer, Columbia, awarded contract to construct 2.2 miles of gravel road; 5,090 cu. yds. gravel; $20,349.

S. C., Chester—R. M. Hudson Co., Atlanta, Ga., awarded contract to constr. 70,000 sq. yds. street paving; $250,000 available.

S. C., Columbia—Concrete Construction Co., 8 Hook Bldg., awarded contract to construct 3.000 yds. walks; 400 yds. driveways, at $16.584.

S. C., Greenwood—W. N. Thompson, Chester, S. C., awarded contract to grade and surf. 11.1 mi. Callison Rd.,—Dixie Hwy. to McCormick county line, at $50,000.

S. C., Spartanburg—Southern Paving and Construction Co., Chattanooga, Tenn., awarded contract for 100,000 sq. yds. asphaltic concrete paving at $239,600.

S. C., Union—General Road & Drainage Construction Co., Columbia, S. C., awarded contract to construct 2,400 lin. ft. walks, grade, drain main rds. surface with topsoil; $125,000; Fed. Aid, $26,000.

S. D., Pierre—State Hwy. Comn. let following contracts: Grading, graveling and draining 12.5 miles Madison-Wentworth Hwy., Lake Co., to D. D. Bidwell, Egan, at $110,055; 15.03 mi. Highmore-Miller Rd. Fed. Aid Proj. No. 18, Hand Co. and 7 mi. same rd. Proj. 19, Hyde Co., to G. W. Humphrey, Pingree, N. D., at $121,993 and $51,979, respectively.

Tenn., Memphis—Tennalaga Constr. Co., Nashville, awarded contract by State Hwy. Dept. to construct 16.35 miles State Hwy. No. 12 betw. Memphis and Millington; 18-ft. bitum. macadam rdway., at $328.694.

Tenn., Nashville—Tennalaga Constr. Co., 220 Capitol Blvd., Nashville, awarded contract for constructing 16.35 miles State Hwy. No. 12, Shelby Co., at $328,694.

Tenn., Nashville—The Tenn.-Ala., Georgia Constr. Co., awarded contract for bldg. block asph. surf. highway from Memphis to Parkfield, at $328 694. Road will be 16 miles long and 18 ft. wide.

Tex., Boston—Arkansas Road Constr. Co., Texarkana, Ark., awarded contr. for grading and surfacing on sec. State Hwy. No. 5; $150,000 available.

Tex., Corpus Christi—Gulf Bithulithic Co., Houston, Tex., awarded contract to construct 150 miles hard-surfaced roads; replace wooden brdgs. with concrete structures. $2,000,000 bonds voted for this work.

Tex. Gainesville—Southern Constr. Co., Dallas, awarded contract to construct 31.000 sq. yds. street paving; Tarvia treatment, at $300,000.

Tex., McKinney—F. D. Perkins, McKinney, awarded contract for constr. of 25 mi. of hwy. in Collin Co., at $228,562.

Tex., Sherman—Kaw Paving Co., Topeka, Kans., awarded contract to pave 14 streets; rein. conc.; $150,000.

Tex., Mt. Vernon—Smith Bros., Crockett, Tex., awarded contract to construct roads, at $500,000, Franklin County.

Va., Cumberland—Following contractors awarded contracts by Cumberland County Commrs. for construction of 21 miles soil roads in Hamilton Dist.: Sanderson & Parker, H. P. Baker & Co., Hamilton Constr. Co., all of Cartersville, Va. $58,378 available.

Va., Danville—J. Thomas & C. L. Bennett, awarded contract for $50,000 worth of street improvements here, at abt. $50,000.

Wn., Davenport—C. M. Payne, Spokane, awarded contract for constr. of Donahue Road No. 5—11 miles long from Harrington south—at $86,348.

Wash., Harrington—C. M. Payne, Spo-

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kane, awarded contract for 11 miles of the Donahue road so. of here, at $86,348.

Wash., Mansfield—Jno. Mohr, Waterville, awarded contract for surfacing 16 miles of road connecting 6-mile surf. road east of town, at $95,000.

Wash., Olympia—J. T. Stickler, Asotin, Wn., awarded contract for improving Inland Empire Hwy., Columbia Co., Dayton-Delaney, at $95,184; General Constr. Co., 444 Payton Bldg., Spokane, awarded contr. for Inland Empire Hwy., Garfield Co., Dodge to Central Ferry, at $184,062.

Wash., Ritzville—Mitchell Bros., Spokane, awarded contract for constr. of permanent highway from present terminus of Rosenoff Road west to the Adams-Grant County lines, at $168,000.

W. Va., Wayne—Stringer, Lockwood & Stringer, Hamlin, W. Va., award. contr. to grade 7 miles Wayne-Ft. Gay Road, at $111,342.

Wis., Madison—B. D. Bidwell, Egan, award. contr. for constructing state hwy.—Moody County line thru Wentworth to Madison—at $150,212.

SEWERAGE & SEWAGE TREATMENT

Ariz., Clifton—Cotey and Black, Clifton, awarded contract for constr. of sewer system for Clifton, at $123,645.

Cal., Fresno—L. Gould, Sacramento, award. contract to construct sewer in No. Fresno Dist., at about $113,000. Cement pipe, 12, 16, 18 and 20-in. diam.; also vitr. pipe 8 and 10 in. wil be laid; Frederickson & Shannon, award. contract for small sewer job in same district, at $41,000.

Cal., Fresno—Frederickson & Shannon, Fresno, awarded contract for constructing sewers in Sewer Dist. No. 10, at $30,861.

Cal., Fresno—H. Gould, Sacramento, awarded contract for constr. of sewers in Municipal Impvt. Dist. No. 1, No. Fresno, at $118,249.

Cal., Riverside—R. T. Shea, Riverside, awarded contract to construct the Jackson Street outfall sewer, betw. Garfield St. and Colorado Ave., at $9,627.

Cal., Tracy—J. E. Johnson, Tracy, awarded contract for installation of sewer and water pipe, at $3,411.

Colo., Burlington—Orman Constr. Co., City, awarded contract to install sewer and water system at $60,000.

Conn., New Canaan—T. F. Foley & Co., So. Norwalk, Conn., awarded contract for new sanitary sewers and drains; also for repair of old system, at cost plus eleven per cent., the Boro. furnishing all materials. Approx. cost $18,000. City Waste Disp. Co., New York City, Engrs.

D. C., Washington—Morton McI. Dukehart & Co., Light St. & Key Hwy., Baltimore, Md., awarded contract at $1,814; F. M. Latham & Co., 1417 Gorsuch Ave., Baltimore, contr. at $41,603.

Ill., Chicago—Jos. Ventrella, awarded contract for tile pipe sewers, brick manholes, brk. catch-basins in N. Laramie Ave.,—39 ft. no. of no. line produced west of Moffatt St. to 415 ft. no. of no. line west of Moffatt St.; also contract for sewer in portion of N. Rockwell St.

Ill., Chicago—Jno. Tirttilli and Nash Di Domenico awarded contracts for drains in portions of Kasson Ave., Kelso Ave., N. Kilpatrick and N. Marmora Aves.

Ill., Rockford—Nick Santucci, Chicago, awarded contract by Bd. Local Impvts., Rockford, for constructing sewers in portions of S. Church St., 16th Ave., Loomis and Buchanan Sts., Mason, Central Aves.

Ind., Indianapolis—Sheehan Constr. Co., awarded contract for local sewer in Rural St.,—Glen Drive to a point 22 ft. south of 25th St., at $4.98 lin. ft. to total of $5,527.

Ia., Chariton—P. E. Johnson, local, awarded contract for sewers on Middle Rd. and Fernwood Ave., at $1,209.

Ia., Chariton—G. W. Ensley, City, awarded contract for constr. of the extension to sewer system, at $22,007.

Ia., Des Moines—City Council awarded following contracts for South Side sewer construction: O. P. Herrick, contract No. 1, at $2.47 per lin. ft.; Alexander & Higbee, contr. No. 2, for main trunk and pumping plant, at $4.79. Total cost of sewer $629,000.

Ia., Glenwood—Katz Constr. Co., Brandeis Theatre Bldg., Omaha, award. contract for sewers at $30,000.

Ia., Kanawha—Hammond-Cruse Constr. Co., Spencer, Iowa, awarded contract for sewer work: J. L. Kalvig, Kanawha, contract for constr. of disposal plant.

Ia., Marshalltown—Anderson & Empie, awarded contract for constructing san. sewer on N. 1st and 2nd Aves., Riverside St. and N. 4th St., at $1.50 per ft. for 8-in., $1.25 for 6-in. laterals to curb, $1.50 for 8 by 6-in. Y branches, $1.50 each for 8-in. elbows, $1.50 each for 8x8-in. T branches, $15 each for lampholes, $87 each for manholes.

Ia., Pocahontas—J. W. Turner Impvt. Co., 309 Youngerman Bldg., Des Moines, Ia., awarded contr. for sewers at $109,612; B. D. Viegel, Webster City, Ia., contr. for disp. plant, at $21,900.

Ia., Red Oak—F. B. Corey, Shenadoah, awarded contract for 8,600 lin. ft. sewers.

Kans., Rosedale—Michael Walsh & Son, award. contr. for sanitary sewer in Waldo Dist., at $40,085.

Mass., Boston—Jno. W. O'Connell, contr. for sewerage works in Oak Ave. and Colorado Street, Dorchester, at $508.20; Timothy Coughlin, for sewerage works in Havelock Street—Morton Street to Blue Hill Ave., Dorchester—at $1,720.

Mass., Boston—Frank Drinkwater, award. contract for sewerage works in Bradlee Street, Thatcher Street, Huntington Ave., Hyde Park, at $11,517; J. W. O'Connell, sewerage wks. in Brown Ave.—Blakemore St. to Garden St., D. Roxbury, at $1,551; Bianco Parenti, for bldg. catch basins and minor drains in Boston, at $5,705; T. Coughlin, for sewerage works in Wilson St., at $2,272.

Mich., Adrian—Kircher Bros., Olivia, Minn., awarded contract for constr. sanitary sewer system; $45,750. Abt. 23,000 ft. vit. sewer pipe.

Mich., Corunna—Victor Mikan, Durand, awarded contract for constr. of half a mile of sewer in third ward here.

Mich., Lansing—D. E. Nipp, award. contr. for constructing sewers in Moores Ave. and Moores Drive and outlet for same, at $3,795; Jno. Bray, contr. for sewers in Clayton St. and Hyland St., at $795, also sewer in Main St., at $685.

Mich., Muskegon—Geo. W. Clark, City, awarded contract for west end sewer construction.

Mich., Pontiac—Following contracts let by City Comn. for sewers: Misak Kevorkian, contr. for san. sewer in Tasmania Ave., at $4,217; Victor Nickoloff, contr. for sewer in Beach St., at $3,312 and one in Jessie St., at $5,182.

Mich., Port Huron—C. Mugovero, Huron Ave., awarded contract for bldg. vitr. crock sewers in Farley, Ballentine, Howard and Porter Sts.—20th to 24th Sts.—at $4,691, $4,944, $5,462 and $4,691, respectively.

Mo., Boonville—Hogan & Haller, Boonville, award. contract to improve sewer system; install additional mains; $11,000. Burns & McDonnell, Engr., Kans. City, Mo.

Mo., Kans. City—Fred. Lorrimer, award. contract to build sanitary sewer within boundaries of Holmes, Oak, 55th and 56th Sts., at $16,000.

Minn., Duluth—Jno. Hedberg, award. contr. for storm sewer in Superior St.—23rd Ave. east to the Gold Club's grounds, at $23,113; Johnson & Hiner, contr. for san. sewer in 105th Ave., west, at $1,353; Jno. Roise, contr. for sewers in 39th Ave., at $1,395.

Minn., Hibbing—J. W. Dohm, City, award. contr. for constructing incinerator, at $53,-700.

Minn., St. Cloud—J. P. Basenius, local, awarded contract for 5 blocks 36-in. segm. sewers in District No. 7, at $14,065.

Minn., St. Paul—Feyen Constr. Co., 277 Burgess St., awarded contract for constructing sewer on Palace St., at $2,074; also Edgecumbe St., at $1,238! also sewer in Myrtle St., at $1,192.

Mont., Shelby—Gerhaz-Jaqueth Engr. Co., awarded contract for sewer system, at $35,000.

Neb., Broken Bow—Gordon Constr. Co., Denver, awarded contract for sewers, at $114,000.

Neb., Ord—Hammond-Cruse Constr. Co., Spencer, Iowa, awarded contract for constr. of sewer system at $56,632.

Neb., Scotts Bluff—J. S. Schwartz. awrd. contract for sewer constr. work in District No. 14, at $4.290.

Neb., Scribner—A. A. Dobson Co., 800 First National Bank Bldg., Lincoln., awarded contract for sewer system, at $49.724.

Neb., Wilbur—Martz Bros., Lincoln, awarded contract for constr. of sewerage system, at $42,000.

N. J., Trenton—G. Boscorello and J. Jiangola, award. contract for constructing drain on Gouverneur Ave.

N. J., Rutherford—Jannarone Constr. Co., Bellevue, N. J., award. contr. for constructing lateral sanitary sewer in Feronia Way, at $1,581; United Engineering Constr. Co., Lodi, N. J., award. contract for sewers in Vanderburg Ave., at $1,521.

N. D., Edgeley—Chas. Harris, Jamestown, awarded contract for sewer system. Work will start in spring.

O., College Corner—T. J. Connelly, Cambridge City, award. contr. to furnish sewer and material and to construct the Inter-State ditch through College Corner, at $16,000.

O., Hamilton—W. M. Davis, awarded contract for santitary sewers and house connections on S. 8th to E. Long; also E. Long—S. 8th to S. 9th Sts., at $5,655.

O., Mansfield—Clyde A. Walb, award. contract for digging six mile open sewer, at $91,000.

O., Sandusky—Homberger & Wager, awarded contract for constructing sewer on Jackson Street—manhole on Market St. to one on Water St., at $4,835.

O., Vermillion—American Construction Co., Cleveland, awarded contract to construct disposal plant, at $28,542; Tony Trifiletti, Lorain, awarded contr. for new sewer and sewerage system, at $51,785.

Okla., Frederick—Healy Constr. Co., Dallas, awarded contract for sewer system, at $21,200; 2 units Imhoff tank; 24x24 ft. conc. constr.

Pa., Allentown—George H. Gardner, awarded preliminary contract for City's house sewerage system, at $134,570.

S. D., Garretson—Fanebust Bros., 802 S. 2nd Ave., Sioux Falls, awarded contr. for 4,300 lin. ft. 8-in. sewer, at $10,000.

S. D., Gettysburg—Wm. Danforth, St. Paul, awarded contract for constr. of sewers, at $51,542.

Tenn., Halls—Fraper & Davis, award. contr. for constructing 14,000 ft. of sewer, at $35,000.

Wash., Seattle—Bd. Public Wks. has decided to construct the Alki sewer system by day labor. Dist. to be served by what is officially known as the 63rd Ave S. W. sewer system which will drain all of the lower levels of the Alki Point Dist., is estimated by City Engr. Dimock to cost $164,-000.

W. Va., Martinsburg—H. C. Brooks Co. and Cox Construction & Lumber Co., awarded contracts for sewage disposal plant; $48,000.

Wis., Green Bay—C. P. Flatley and Jno. Brogan, awarded contracts for sewers on 14 streets.

Wis., Milwaukee—M. Synovitz, 944 Second Ave., award. contr. for constructing sewer on Hubbard St., at $2.42 per lin. ft., or $1,308; sewer on 21st St., at $2.29 per lin. ft. or $3,486.

Wis., Sheboygan—Olson & Murphy, local, awarded contract for sewers in St. Clair Ave.

WATER SUPPLY AND PURIFICATION

Cal., Los Angeles—James Jones Co., 201 Leroy St., City, awarded contract for furnishing 2,000 ⅝-in. rdway curb cocks at 70c each and 200 2-in. rdway curb cocks at $6.00 each.

Colo., Pueblo—Orman Construction Co., City, awarded contract to install water system and sewer system at Burlington, at $60,000.

Conn., East Hartford—(Hartford, P. O.) —Beaver Engineering and Contracting Co., 51 Chambers Street, New York City, awarded contract by Fire Dist. Commrs., for bldg. extensions to water works system.

Ida., Lewiston—Pittsburg Meter Co., awarded contract for 100 water meters, at $10.75 f. o. b. Seattle.

Ill., Chicago—Malachy Murphy awarded contract for water supply pipe in Archer Ave.—So. Mobile to So. Neenan Ave.; also in W. 83rd Pl., S. Hamlin Ave. to So. Kedzie Ave.; M. J. Bohan, awarded contract for water supply pipes in S. Avers Ave.—W. 55th St. to W. 54th St., in So. Fairfield Ave.—W. 47th to W. 48th Sts.; also in S. Green St.—West 52nd St. to 379.25 ft. so. of W. 52nd St.

Ia., Sheldon—Des Moines Bridge & Iron Works, Tuttle bet. 9th and 11th, Des Moines, award. contract for water works impvts., at $14,800.

Ia., Sioux City—W. B. Carter, Sioux City, awarded contract for water works extensions and sewers, at $40,000.

Kans., Elk City—Johnson, Morris & Hill, Independence, awarded contr. for bldg. water works system and filtration plant, at about $21,500.

La., Natchitoches—Spencer & Hinkley, Shreveport, La., awarded contr. for water and light improvements, at $7,026.

Mass., Boston—V. Grande awarded contract for laying and relaying water pipes in Arch St.—Franklin St., A St., Main St., Gibbs Court, Waldemar Ave., etc., at $3,561.

Mich., Royal Oak—T. C. Brooks & Son, West Grand Blvd., Detroit, award. contract by Baker Land Co., to build complete water works system, involving 12,049 ft. 6-8-in. pipe, 47 6-8-in. valves, 47 valve boxes and 5 hydrants, at $26,490.

Minn., Duluth—Johnson & Heiner, local, awarded contract for laying water and gas mains—8th Ave. E. to Chambers Div., in 13th St. and in Snuperior St.—31st Ave. E. to Congdon Pk., from Congdon Pk. to 36th Ave. East, at $3,520.

Minn., Ironton—Pastoret Construction Co., 510 Lyceum Bldg., Duluth, awarded contract for concrete shaft and installing pump for village, at $13,192.

Minn., Mora—Jno. W. Hildred & Co., 33 E. Third St., St. Paul, Minn., awarded contract for installing Keystone two-stroke pump, 10-h.p., at $3,044.

Mont., Butte—Following contracts awarded by Butte Water Company for construction of a combination wooden and steel pipe line from Big Hole pumping station to Butte: 3,674 ft. 26-in. steel pipe and 22,368 ft. 24-in. steel pipe, to the National Tube Co., at $192,374; 44,216 lin. ft. 26-in. continuous Redwood Stave pipe and 72,231 ft. 24-in. contniuous Redwood Stave pipe, and 72,231 ft. 24-in. continuous Redwood Stave pipe, to Redwood Manufacturers Co., San Francisco, Cal., at $383,060; Ludlow Valve Mfg. Co., Troy, N. Y., contract for valves, at $20,000.

Mont., Musselshell—Security Bridge Co., Billings, awarded contract for construction of city water system. Work includes drilling of well of sufficient size and depth to supply town's needs; 50,000-gal. storage reservoir, with complete pumping outfit, mains and supply pipes.

Mont., Roundup—C. P. Tillman awarded contract for placing lead service pipe from water main to edge of paving on Main St.—Fourth to 8th Aves.—at $2,270; Security Bridge Co., Billings, awarded contract for placing pipe to connect present water works system with new million-gallon reservoir, at $10,528.

Neb., Chadron—Katz Construction Co., 408 Brandeis Bldg., Omaha, awarded contract for water system. Est. cost abt. $160,000.

Neb., Ord—Hammen-Kruse Constr. Co., Spencer, Ia., awarded contract for construction of water works system, at $10,300; also sewers, at $97,000.

Neb., Lincoln—Martin Day Constr. Co., awarded contract for a $2,000,000-gal. reservoir by the A Street pumping station, at cost of $37,800.

Neb., Norfolk—Norfolk Bridge & Constr. Co., Norfolk, awarded contract for water extensions, at $17,500.

Neb., Venango—Hennessy & Co., Omaha, awarded contract for water plant at $26,000.

N. J., Perth Amboy—Liddle & Pfeiffer awarded contract for furnishing lead, tools, labor, material, etc., etc., necessary to haul from Runyon pumping station to Old Bricks and lay complete in place, cast iron bell and spigot; together with valves.

N. Y., New York City—J. G. White Enginering Corp., New York City, awarded contract for the engineering and construction of 225 miles of oil pipe line, pumping stations and tankage in Texas.

N. C., Franklinton—J. J. Quin & Co., Durham, N. C., awarded contract for water and sewer systems, at $93,000.

O., Ashtabula—City Mgr. will enter into contract with the Ashtabula Water Supply Co., for laying a 6-in. main from Lake Street to the lighting plant.

O., Canton—Keller K. Huff, City, awarded contract for bldg. new receiving basin, 1,500,000-gals. capy.

Okla., Ada—Merkle Machinery Co., 508 Interstate Bldg., Kans. City, Mo., awarded contract for furnishing and installing two 750-gal. per minute turbine pumps and 100-h.p. motors, 2 1,250-gal. per minute Underwriter turbine fire pumps and 200-h.p. motors, 3 panel switchbd. complete, with wiring, recording Venturi meter, all piping, valves and fitting and one 10-in. automatic hydraulic valve, etc., at about $20,500.

Okla., Afton—Smith & Whitney, Southwestern Life Bldg., Dallas Tex., awarded contract for extending water works system, at about $20,000.

Okla., Hartshorn—N. S. Sherman Machine & Iron Work, awarded contract for water purification plant; brick and concrete; 500,000 gals per minute, $25,000; filter equipt., basins, filter-house, etc., $25,085; using Pittsburgh filter equipt.

Tex., Beaumont—New York Continental New Filtering Co. awarded contr. for the installation of two new filter units.

Tex., El Paso—Layne & Bowler Co., Memphis, Tenn., will instal pump; 1.725,000 to 2,000,000 gals. daily; settling basin or sand trap.

Tex., Luling—Luling Water Works Co., awarded contract for sinking test wells to secure supply of artesian water. New mains will also be laid in parts of town where needed.

Tex., Port Arthur—Pittsburgh-Des Moines Steel Co., Dallas, Tex., award. contract to construct 300-gal. steel water tank in Kilman Circle, at $24,000.

Utah, Ogden—F. Berne & Co. awarded contract for constructing rein. conc. aqueduct for Wilson Irrig. Co., at $27,200.

Wash., Seattle—Following contracts let by Board Public Works, involving expenditures of $424,685: Jahn & Bressi, water main in W. 60th Street, et al., at $141,723; Jahn & Bressi, water mains in West 61st St., et al., at $135,884; S. A. Moceri, water mains in W. 45th Street, et al., at $147,077.

Wis., Stoughton—U. S. Engine, Windmill & Pump Co., Batavia, Illinois, awarded contract for water tank. Owner, Moline Co., Stoughton; 20x20, rets on steel beams.

BRIDGES AND BUILDINGS

Ark., Fayetteville—Killough Bros., Chandler, Okla., awarded contr. for pipe and concrete culverts at $40,156; also bridge and abutments at $3,650; Vincennes Bridge Co., Vincennes, Ind., award. contr. for 60-ft. brdg. and abutments, at $3,587.

Cal., Fresno—J. E. Mitchell award. contr., at $3,431 for constructing rein. conc. bridge over Fowler switch.

Cal., Modesto—Ernest Green award. contract for rein. conc. bridge 1,400 ft. long, over Merced River on Hilmar-Irwin-Stevenson Rd., at $112,600.

Cal., Oakland—Breese & Burgund awarded contract by Bd. of Supvrs. for constr. of two bridges on Redwood Canyon Rd., at $5,590.

Cal., Red Bluff—Boardwell & Zimmerman award. contr. for constructing Capay Rancho brdgs., at $5,084, $3,510 for bridges 1, 2 and 3; C. E. McCartney award. contr. for constructing bridge over Cold Fork Cotton wood Crk. in western sect. of county, at $4,400; Hart Constr. Co. award. contr. for constructing bridges across Oak Creek, at $3,398.

Cal., Redwood City—C. L. Lindgren, Burlingame, award. contract for 3 brdgs. over Redwood Creek, at $26,547.

Cal., San Diego—B. B. Boyd awarded

Full-Revolving, Self-Propelling
LOCOMOTIVE CRANES

Mounted on Traction Road Wheels.
Equipped with 30-ft. Booms and ¾-yard Clamshell Buckets.

ALL BRAND NEW

F. MAYER
53 W. Jackson Blvd. CHICAGO.

contract for erection of Jacumba bridge to be built of rein. conc., at $7,226.

Cal., San Jose—Herschback & Sciarrino award. contract for constr. of conc. bridge over Calabasas Crk. on Pierce Rd., at $13,-634; Wm. Martin award. contract to build bridge on Bubb Rd. at Hanrahan Pl., at $3,900; also culverts on Villa Vista Rd., at $1,955.

Cal., San Jose—J. H. Miller award contract for rein. conc. bridge at Alam Rock Ave., at $10,993.

Cal., San Jose—J. H. Miller, San Jose, awarded contract for constructing a rein. conc. bridge for the county on Hillside Ave., at $5,230.

Fla., Punta Gorda—Murphy & Maloney will complete conc. brdg. spanning bay betw. Punta Gorda and town of Charlotte Harbor, at $79,000.

Ga., Amercus—Luten Bridge Co., York, Pa., award. contract for constr. of 3 concrete and steel bridges on Dixie Hwy. on Andersonville Rd., at $35,869.

Ida., Homedale—U. S. Steel Bridge Co., Montana, awarded contract for bridge over Snake River, at $100,000.

Ill., Springfield—Harry C. Holmes, Macomb, Ill., awarded contract for constr. of bridge No. 27 and bridg. No. 36, Sect. R, Route 4A and 5A, McDonough Co., at $5,540.

Ill., Springfield—John R. Sleeter, awarded contract for construction of the Summers and Brashears bridges in road districts Nos. 4 and 5, Massac County, at $2,362 and $1,260, respectively.

Ind., Brazil—W. H. Rupert awarded contract for Houk brdg., $900; Stewart brdg., $1,000; Collins brdg., $1,500; Lester brdg., $1,500, and Brown brdg., $900; Chas. Rhodes, award. contr. for Helton brdg., Sugar Ridge Twp., at $1,296.

Ia., Cedar Rapids—Koss Constr. Co., 2815 5th St., Des Moines, awarded general contract for bridge; reinf. steel contr. to Corrugated Bar Co., Chicago, Ill.; cement, Northwestern Cement Co., Mason City, Ia.; Universal Portland Cement Co., Chicago; six 100-ft. conc. spans, 90-ft. rdway. $420,000.

Ia., Denison—Deloit Bridge Co., Dennison, awarded contract for two iron bridges and cement culverts on Lincoln Hwy., Harrison Co., at $74,000.

Kans., Lawrence—O. C. Clark & Co., Topeka, awarded contract for bridge at Brown's Grove, at $13,479; Horace Young, Lawrence, contr. for bldg. 3 small conc. bridges in Eudora Twp.

Kans., Parsons—Glooy Constr. Co., Monette, Mo., awarded contr. for construction or brdgs. on the O. T. Trail, out of Oswego thru Altamont and Mound Valley. Work on bridges est. to cost abt. $60,000.

Md., Leonardtown—Jos. Shenton, Leonardtown, award. contract for double 15-ft. span steel, conc. slab, timber pile bridge from St. Georges Island to mainland, $10,-000.

Mass., Boston—Cartor Engineering Co., Canton, Mass., awarded contr. for widening bridge and bldg. approaches to state highway in town of Freetown, at $6,685.

Mich., Lansing—Following contracts let by State Highway Department: Over Cedar Creek, Lapeer Co., No. Branch Twp., F. S. Frisbie, Fruitport, $6,699; over Shebion drain, Huron Co., Fairhaven Twp., Murray & Fremont Bad Axe, $6,065; over Wissicogge River, Tuscola Co., Columbia Twp., to Murray & Freman, Bad Axe, at $7,800; State Reward brdg. over Rush Bed drain, Shiawassee Co., Venice Twp., to W. H. Demuth, Owosso, $4,690.

Mich., Lansing—B. C. Lord, Clayton, Mich., award. contr. for conc. work on bridge over Beacon Creek, Lenawee Co., Dover Twp., at $3,540; Elkhart Brdg. Co., Elkhart, Ind., contr. for steel work.

Mich., Lansing—Contracts for bridges awarded by State Highway as follows: Alger Co., Au Train Twp. over Au Train River, 40-ft. rein. conc. Illinois Bridge Co., Chicago, at $6,490; Berrien Co., Watervliet Twp. over Mill Crk., 2 12-ft. abutms., Ira J. Lyons, St. Joseph, $5,000; Watervliet Twp., over Mill Crk., 55-ft. plate girder, Central States Brdg. Co., Indianapolis, $1,881; Branch Co., Bethel Twp., over Swan Crk., 40-ft. rein. conc. girder, to Ben Hicks, Eaton Rapids, $6,197; Delta Co., Nahma Twp. over Bull Run Crk., 35-ft. rein. conc. girder, Sam Mills, Escanaba, $4,610; Huron Co., Rubicon Twp., over Creek, 35-ft. rein. conc. girder, Murray & Fremont, Bad Axe, $3,900; Ottawa Co., Olive Twp. over Pigeon River, 55-ft. plate girder, Brookville Brdg. Co., Brookvile, O., at $2,736; St. Joseph Co., Lockport Twp., over Prairie River, 2 15-ft. plain concrete abutments, Ira J. Lyons, St. Joseph, $7,500.

Minn., Breckenridge—Great Northern Bridge Co., Wahpeton, N. D., award. contract for 40-ft. span and to Joliet Bridge & Constr. Co., 122 S. Michigan Ave., Chicago.

Minn., Gaylord—Independent Bridge Co., Victoria, award. contract for concrete brdg. across county ditch on State Rd. No. 1.

Minn., Pine City—Pine County Board awarded contracts as follows: Over Kettle River in Kettle River Town, betw. sects. 29 and 30, to E. J. Fennely, at $5,980; Birch Crk. town near Denham over Birch Creek, to same contractor at $3,350; town of Kerrick, betw. sects. 25 & 26, to Iowa Bridge Co., at $3,587; betw. sects. 28 and 29 in Rock Crk. Town, to Fred Gustafson, at $2,900; Iowa Bridge Co. also awarded contract for reflooring bridge over Kettle River in Kettle River Town, at $1,646.

Mont., Billings—Mr. Templeton, Casper, awarded contract for bldg. bridge across the North Platte and over Casper Creek at cost of $104,000.

Neb., Shelton—General Construction Co., Plymouth Bldg., Minneapolis, awarded contract for bridge over Platte river near here.

N. J., Trenton—W. H. Schrimp & Co., Perth Amboy, awarded contract for construction Bridge No. 32, Route 6, at $7,488; also Bridge No. 33, Route 6, at $18,666; also Bridge No. 60, at $55,548.

N. M., Santa Fe—Midland Bridge Co., awarded contract by Co. Commrs. Valencia Co. for new brdg. across the Rio Grande east of Los Lunas. This will be an all rein. conc. structure, 926 ft. long, built on piling. Total cost abt. $56,000.

N. Y., Cuba—J. B. Smith, Cuba, N. Y., awarded contract for bldg. thru plate gird. brdg. over Cuba Reservoir Spillway, Cuba-Lean Hwy., at $19,905.

N. C., Avondale—Atlantic Bridge Co., Charlotte, awarded contract for steel brdg., conc. floor, across Second Broad River, at $17,360.

N. C., Rutherfordton—Atlantic Bridge Co., Charlotte, award. contract for bldg. steel brdg., conc. floor, on Avondale St., at $17,360.

O., Columbus—Contracts for superstruct. for Hayden Run brdg. over Hayden Run on Dublin Rd. and 3 brdgs. over north fork of Indian Run on Brand and Jerome Rds., and in Washington Twp., awarded by Co. Commrs. Franklin Co., to E. M. Scully, 1431 Eastwood Ave., at $4,700, $1,600, $1,900 and $2,400, respectively; 3 brdgs. over Rocky Fork Crk. at Taylor Pike, Boehm Rd. and Lorenzo Taylor Farm; also creo. lumber and blk. floor on brdg. over Black Lick Crk. on Reynoldsburg Pike, to Columbus Sheet Metal Co., 75 W. Lynn St., at $2,595, $2,515, $2,345 and $4,160, respectively.

Pa., Ebensburg—Elder & Evans, award. contr. for constructing rein. conc. bridge over Slate Run, at $4,542.

Pa., Gettysburg—G. A. & F. M. Wagaman, Dallastown, York Co., award. contract to constr. bridge over Rock Creek at eastern border of Gettysburg on Lincoln Hwy.; W. H. Drawbaugh, Dover, awarded contr. for bridge over same stream on Harrisburg road.

Pa., Philadelphia—Seeds and Derham, City, awarded contract for construction of $800,000 bridge across the Schuylkill River connecting East and West Conshohocken. Work has already started. Plans call for 8 spans 116-ft. each and 2 80-ft. each with triangular plaza at western terminus; also 30-ft. rdway. with an 8-ft. walk on either side.

S. D., Yankton—Monarch Engineering Co., Falls City, Neb., awarded contract for 584 cu. yds. Cl. A conc., 129 cu. yds. Cl. B concrete; 30,617 lbs. rein. steel; 129,000 lbs. struc. steel; 1,120 lin. ft. piling, 1,460 cu. yds. excav., at $26,501.

Tenn., Memphis—Larimer & Burgess, Memphis, awarded contract to construct 42 bridges in Crittenden Co., Arkansas, at $212,000. Brdgs. will be of two types; one of rein. conc. gird. spans; the other steel plate girders. Some of the brdgs. will be a comb. of the 2 types.

Tex., Paris—Standish & Allen, Chicago, awarded contract for constr. of steel brdg. across Red River; Virginia Bridge & Iron Co., Roanoke, Va., awarded contract for the steel. Bridge will be steel throughout with exception of floor which will be of extra heavy heart pine properly creosoted.

Wn., Yakima—Union Bridge Co., award. contrs. for Piland brdg., (to reconstruct) at $17,890; and steel span betw. Burna and Toppenish, at $7,352; also contr. of Luten arch. conc. span at $4,500.

Wis., W. Allis—Stein Constr. Co., 204 Grand Ave., Milwaukee, awarded contract for conc. brdg. at George St., at $9,750.

Wis., Oshkosh—Ganther & Kroyer, Oshkosh, awarded contract for stone bridge in South Park, at $4,279.

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Sheffield—Concrete blvd. to cost bet. fifty and sixty thousand dollars will be constructed bet. Sheffield and Tuscumbua and from Sheffield to the bridge over the Tennessee river near Florence Blvd. as planned would be not less than 40 ft. wide and 6 miles in length.

Ariz., Phoenix—Proceedings under way for additional paving as follows: Portland Street—Central Ave. to 7th St.; Van Buren St.—7th Ave to 15th Ave.; First St.—Willetta St. to McDowell Rd.; Adams St.—7th Ave. to 17th Ave.; Monroe St.—12th Ave. to 15th Ave. and 12th & 15th Aves.—Adams St. to Monroe St.

Ariz., Phoenix—Maricopa County Hwy. Comn. will be ready to ask bids for constr. work shortly after Jan. 1st. Stand. types of perm. rds., including crushed rock with bitum. surf., asph. conc. and cem. conc. will be built. Contracts will be let in big units. Comn. will construct largest mileage possible under the $4,000,000 bond issue.

Ariz., Yuma—$1,200,000 hwy. bonds carried at recent election in Yuma Co. County will also have $150,000 available from fed. aid funds for rd. constr. An important rd. which will be built will extend from Yuma to the Pima county line connect'g. with Pima County's proposed road from Tucson via Ajo to Yuma Co.

Ark., Pine Bluff—Estimate of cost of proposed impvts. in Paving Dist. No. 47 submitted by Commrs. at City Council meeting. The paving of Ninth Ave. Co., Walnut, 11th and 12th Aves. from Olive to Laurel wil cost $48,902; Oak street—Barraque to 6th Ave., $14,273.

Cal., Gridley—Plans and specfs. for paving laid before city trustees. City Engineer Jno. Felleman's plans call for paving Hazel St. east and west to city limits from points of completion of present paving; Sycamore St.—east city limits to west property line of Indiana Street; Spruce St.—west property line of Virginia St.; Indiana St.—So. gutter line of Spruce St. to no. property line of Sycamore St.

Cal., Hemet—Petitions being circulated for impvt. of about two miles of city streets, including portions of State, Harvard, Carmalita, Latham and Devonshire Aves.

Cal., Imperial—$35,000 bonds to resurface Main St. and Imperial Ave., $20,000 to pave approaches to Imperial Ave., and $25,000 to pave approaches to Main St., carried at special election.

Cal., Los Angeles—County Supvrs. preparing to pave section of state hwy. from Castaic to the Ventura Co. line; 5.6 miles in length with 5 ins. of concrete, 18 ft. wide. Est. cost abt. $130,000.

Cal., Orange—Plans and specfs. for paving S. Glassell St., N. Glassell St., E. Collins Ave. and N. Tustin St., approved by the city trustees and proceedings for the impvts. will be started at once.

Cal., Riverside—County Surveyor Fulmor authorized to prepare plans for road district, petition for which has been presented to Supvrs. by residents of Oasis, Mecca and Thermal. It is proposed to build conc. rd. 16-ft. wide betw. state highway at Thermal and Mecca—about 13 miles. Est. cost $250,000.

Cal., San Diego—City Council has adopted Resolution to pave Kalmia St.—Albatross to First sts.—concrete base and asph. surf. Fred A. Rhodes, City Engr. Plans prepared for paving rdway. 24-ft. wide with decomposed granite on Merlin, Hollywood and Radio drives and Orange and Mallard Sts.

Cal., San Diego—$2,300,000 county highway bond issue to construct 135 miles of paved roads carried at recent election.

Cal., San Diego—Bids wil be asked in

near future by Pub. Wks. Officer of 12th Naval Dist., Timken Bldg., San Diego, for constructing macadam roads at the Chollas heights radio station. New rds. will connect with main thoroughfare at E. San Diego and with highway leading into Lemon Grove. Bids will also be taken, at the same time, for sewer construction.

Cal., Santa Monica—City Comn. has decided to pave Second St., with 2½-in. asph. conc. base and a 1½-in. asph. surface, instead of bithu., as originally planned. There will be 217,510 sq. ft. paving.

Cal., Ventura—Resident of the Rincon District have petitioned the Co. Supvrs. to macadamize the Rincon canyon road.

Colo., Colorado Springs—In addn. to paving 4 main thoroughfares next spring, city authorities have completed detailed plans for paving all alleys in downtown district at est. cost to property owners of $35,000. Concrete will be used and there are 12,600 sq. yds. to be paved.

Ga., Carrollton—Carroll Co. Commrs. Rds. & Revenues wil ask bids abt. January 1st for 115 miles sand-clay roads; $500,000. J. Lowe Zachery, Engr., Atlanta. W. M. Robinson, Commr.

Ia., Sheldon—City plans to put in 45 blks. of paving next season.

Ida., Caldwell—Farmers in Deer Flat and other farming sects. south of here are planning to organize local highway district to improve roads. Propose making paved road reaching from here so. in horseshoe shape, returning here. Approx. 30 miles.

Idaho, Lewiston—Council has decided to proceed with impvt. of Dist. No. 12 and has instructed City Atty. to draw up resolution to that effect. Cost of work will approximate $54,000.

Ill., Aurora—Plans for paving of at least 12 streets here are to be taken up by Board of Local Impvts. Six petitions are on file and six more are being circulated. It is planned to have Ord. passed, contracts awarded during winter and work started early in spring.

Ill., Bloomington—Plans and ests. for paving (brk.) on Towanda Ave., have been approved by Bd. Local Impvts. Est. cost $12,615. Ests. provide for stone curb from Monroe street north to corp. limits.

Ill., Decatur—City considering repaving in spring sections of Wood, Eldorado, 7th, W. Main, E. Cerro Gordo, Jasper, Broadway and Morgan Sts. Program as mapped out will mean an expendt. of at least $500,000 for new pavements.

Ill., Quincy—Ord. passed by Council to pave from Main St., to 24th with wooden blocks.

Ill., Springfield—Petitions filed with Bd. Local Impvts. for brick pavements on portions of about 12 thoroughfares. Estimates and plans being prepared by City Engr. Wade Seeley. Impvts. wil be passed upon favorably by Board and Ords. prepared as soon as estimates are completed.

Ind., Columbia City—City Engineer Bollinger instructed to draw plans and specfs. for paving Ellsworth Street from end to end. Pavement will be 26 ft. wide. He will also prepare plans and specfs. for paving North St.—Main to Washington Sts., half a blk. and from no. limit to Ellsworth St., or entire length. Pavement to be 26 ft. wide; also plans and specfs. for paving Oak St.—Ellsworth Street No. to Park Street; 26 ft. wide.

Ind., Elkhart—Bd. of Public Works has instructed City Engr. H. J. Weaver to prepare plans and specfs. for paving S. 6th St.—Hickory St. to Cleveland Ave.—about 5 blocks.

Ind., Indianapolis—Bd. of Wks. adopted resolutions for perm. impvt. of Dexter St.—18th St. to 22nd St.; grading & cem. walks in 23rd St.—Schurmann Ave. to Parkway Blvd.; paving Capitol Ave.—Mobile St. to Smith St. and Louisiana St.—Illinois St. to Capitol Ave.

Ind., La Porte—Plans and specfs. for paving First St.—westerly line of Indiana Ave. to westerly line of Jefferson Ave., approved by Bd. of Public Wks. Six types of paving material specified, estimated cost of which will be figured after bids of the contractors have been made. Plans and specfs. submitted, also, covering paving of G street—southerly line of First street to northerly line of Third St.

Ind., So. Bend—$112,125 will be spent by County for impvt. of hwys. Geo. Y. Helper, in charge of county's hwy. department.

Ind., Vincennes—Three petitions asking for paving city streets with asphalt, filed with Board of Works.

Ia., Garner—City has voted $200,000 bonds for paving. H. V. Reed, Co. Aud.

Iowa, Sheldon—Town will put in 45 blks. new paving in 1920.

Ia., Sioux City—City plans paving Dakota St., 2½ miles long, and No. 13 road thru So. Sioux City to Dakota City on to Homer, Neb., both jobs to be started in Spring. J. L. Phillips, So. Sioux City, Mayor.

Ia., Storm Lake—Daniel Boone Hwy. being surveyed for paving thru towns of Bancroft and Ledyard.

Kans., Hutchinson—Ord. passed providing for paving on Monroe St.—17th to 23d Sts. and on 15th—Maple to Plum Sts. Plans call for a 32-ft. pavement—3-in. brk. with asph. filler on conc. base.

Kans., Pittsburg—Co. Commrs. in favor of joining with city in paving Broadway—24th St. to connect with proposed county paving.

Ky., Carrollton—The $150,000 rd. bond issue in Carroll Co. carried. Portion of the sum will be used on Louisville-Cincinnati Fed. Hwy.

La., Monroe—$498,000 bonds voted to construct streets and improve railway tracks. Walter G. Kirkpatrick, Consit. Engr.

La., Monroe—$1,450,000 bonds voted for rebldg. streets, municipal plants, etc.

Mich., Big Rapids—City Commission proposes to pave 5½ miles of streets in city; work to be started in spring.

Mich., Charlotte—Bd. Co. Commrs. recommends that $31,500 be raised for constr. of roads, including abt. ½-mi. and 100 rds. on Charlotte and Olivet Road; also 1 mi. on Charlotte & Vermontville Rd; $4,000 for new brdg. on Thornapple River on Charlotte and Vermontville Rd., Vermontville Twp.; $6,000 for rd. machinery and $20,000 for repair of roads.

Mich., Charlotte—South Main St. will be paved from end of present pavement to water works—abt. a mile. Cement bridge will also be built to take place of present structure.

Mich., Jackson—Jackson County considering expendt. of $1,400,000 for road improvements.

Mich., Mt. Pleasant—A paved road may be built betw. here and Lansing via Shepard, Alma, Ithaca, and St. Johns. Mt. Pleasant will make an energetic campaign for the improvement.

Minn., Blooming Prairie—To take bids in January on abt. 15,000 sq. yds. paving; alt. bids on various materials. Consit. Engr. Jno. W. Shaffer & Co., 501 N. Y. Life Bldg., Minneapolis. T. J. Cashman, Vil. Clk.

Minn., Cass Lake—Surveys completed and plans now being prepared by U. S. Bureau of Public Roads, Minneapolis, for 31 miles of road; partly surfaced with gr., thru Minn. National Forest from Cass Lake to Ball Club. E. C. Hathaway, Dist. Engr., 224 Post Office Bldg., Minneapolis. C. D. Baker, Aud. Cass County.

Minn., Crookston—Polk Co. Commrs. have voted and carried $250,000 for constr. of roads in 1920. Henry J. White, Co. Aud.

Minn., Hutchinson—Bids to be asked in January on paving. $200,000. Alt. bids on various materials. Jno. W. Shaffer & Co., Minneapolis, Consit. Engrs. F. N. Moore, City Clk.

Minn., Luverne—Resolution adopted to pave approx. 100 blocks in city. Plans with T. H. Johnson, 32nd and Myrtle Sts., Sioux City, Ia. Wm. Bauer, City Recorder.

Minn., Madison—Will take bids in January on paving 40,000 sq. yds., alt. bids on various types. Jno. W. Shaffer & Co., 500 N. Y. Life Bldg., Minneapolis, Consit. Engr. Vil. Clk. M. T. Hoff.

Minn., St. Paul—Ramsey County considering constr. of highway next spring from Mendota, Minn., to St. Paul. May later cover with Tarvia. Est. cost $10,000. Robt. R. Godfrey.

Minn., St. Paul—County contemplates bldg. 6 miles of pavement on the White Bear main road and 1½ miles on Snelling-New Brighton Rd., in 1920.

Minn., St. Paul—There is $1,016,500 worth of city paving waiting to be laid here. Final orders for this amount have been passed.

Minn., Slayton—Will ask bids in spring on about 25 blocks of paving; alt. bids on various materials. Jno. W. Shaffer & Co., Engrs., Minneapolis. Bert Tieteman, Vil. Rec.

Miss., Winona—City considering paving bus. sect. with wood blocks; gravel streets in residence section.

Mo., Jefferson City—State Hwy. Rd. and County Court of St. Louis Co., have reached understanding with reference to constr. of 4 general hwys. from St. Louis west thru the county. Hwys. are known as the St. Charles, Manchester, Gravois and Lemay Ferry Roads. Brick and concrete will be materials used for most part and cost will be about $2,000,000.

Mo., Jefferson City—State Hwy. Bd. approved applications for 41.25 mi. road; $101,-173; Ralls Co.,—37 miles, gravel road, $146,-519; Lewis Co.—4.25 miles 16-ft. gravel La Belle-Monticello Road, $44,653.

Mo., St. Joseph—Jno. D. Mohler, Spcl. Co. Engr., will at once begin work preliminary to hard surfacing the Agency Road betw. Saxton Rd. and Agency—6.5 miles. Hwy. is to have conc. wearing surf., 18-ft. wide on a 6-in. macadam base and will cost approximately $30,000 a mile.

Mo., Trenton—$135,000 bonds voted for road construction; 12 miles Trenton Twp.,

Used Road Building Equipment For Sale

AT REDUCED PRICES

1—Cummer 1800-yard Road Asphalt Plant.

1—Twelve-Ton, 24-inch Gauge, Geared Locomotive.

6—Road Rollers, 2½, 8 and 10-ton.

1—Noyes Crusher for Re-working Old Asphalt.

Locomotive Cranes, Hoisting Engines, Buckets, Dump Cars and Other Equipment.

F. MAYER, 53 W. JACKSON BOULEVARD CHICAGO, ILLINOIS

Grundy Co. $300,000 state and federal aid.

Mont., Hardin—City plans about 60 additional blocks of paving.

Mont., Hardin—$75,000 road bonds sold. Work will begin in Spring on Big Horn County roads. R. P. Ross, Aud.

Mont. Helena—Following are included among road impvts. planned by State Highway Comn.: Deer Lodge Co., Anaconda county seat, Anaconda Butte Rd., 11 miles paving; E. E. Bailey, Co. Aud.; Fergus Co., Lewistown county seat; Hilger-Roy Rd. and Great Falls-Lewistown Rd.

Mont., Helena—Application for approval of a 12½-mi. road project thru Broadwater county, connecting with Bozeman-Helena Hwy. has been made to State Hwy. Comn.

Neb., Aurora—Will soon take bids on 58 blocks of paving. G. R. Haworth, City Clk.; Jno. A. Bruce, 501 City Hall, Omaha, Consit. Engr. Asso. Engr. Grup & Walter, 204 Peters Trust Bldg., Omaha. Plans to be completed in December.

N. J., Trenton—$1,000,000 bonds voted to construct one mile blvd. over Sanhican Crk. through city. Engr. not selected.

Neb., Alliance—Paving Dist. No. 3 created. Will probably take bids this month on various types of paving. Includes Box Butte Ave., 5th, 6th, 7th, 8th, 9th and 10th Streets. Grace H. Kennedy, City Clk.

N. C., Coats—Town plans municipal improvements and contemplates issuing bonds for the work. Barrow, McDaniel & Betts, Engrs.

N. D., Bismarck—Prelim. plans made for grading 23 miles of Wonderland Trail; 26 miles betw. Minot and Max; 15 miles no. of Minot and 28 miles out of Green Trail betw. Minot and Kenmare. W. H. Robinson, Chf. State Engr.

O., Cincinnati—City plans expendt. of $1,500,000 for street impvts. Following Sts. on program: Central Ave.—Liberty to Baymiller; Eastern-Ferry to Lumber; Harrison Ave.—Madison Rd., Quebec Rd., Hamilton Ave., Fairbanks Ave., Freeman Ave., Baymiller St., Fourth St. and Main St. This is tentative program decided upon by City Engr. Krug.

O., Cleveland—E. A. Kemmler, City Supt. Hwys. is working on plans for 30 miles of paving and sidewalks to be completed next year.

O., Columbus—Franklin County Commrs. will co-operate with State Hwy. Dept., in improving the Hague Ave. Rd., west one mile; also N. High—end of present paved sect. to Worthington and strip at Glenmary Park—will be paved. Approx. 50 petitions for road improvements are on file in County Commrs. office.

O., Findlay—Plans for hwy. impvts., involving expendt. of betw. one and two hundred thousand dollars for 1920, outlined at conference betw. State Hwy. Commr. Taylor and Hancock County Commrs. Among proposed impvts. is the repair of 9 miles between Findlay and Carey on Toledo-Columbus Hwy., passing thru Bowling Green, Carey, Findlay, Upper Sandusky, Marion and Delaware.

O., Mansfield—Petitions for impvt. of 21 city streets are in the hands of city officials. Council has announced a determination to settle the 1920 program at early date so engineers may start immediately and bids be let soon after first of year.

Okla., El Reno—65 blocks of paving for city are contemplated in resolutions published by City Commrs. Several other contracts will be let soon if the one now under consideration proves satisfactory.

Okla., Marlow—Proceedings under way to pave principal streets. V. V. Long & Co., Engrs., 1300 Colcord Bldg., Okla. City., Okla. Geo. L. Orr, City Clerk.

Okla., Norman—City Commrs. have ordered plans and specfs. prepared for paving 31 additional blocks in City.

Okla., Pawhuska—City will pave 200 blks. of streets.

Ore., Grants Pass—Bldg. of hwy. to Josephine Co. caves is to proceed immediately. Forestry Dept. has approved proj. and issued instructions covering location survey preliminary to letting contr. as soon as grading is possible in Spring. Rd. is to be 10-ft. wide.

Pa., Chester—Council passed new loan of $400,000 and funds will be used for opening, grading, widening and paving of streets, sewers, street clean'g. equipt., fire apparatus, disp. plants & other impvts.

Pa., Sharon—Main road from Sharon to Warren, Ohio, is to be permanently improved by co-operation betw. states of Ohio and Penn. Rds. to be improved are from Erie to Conneaut; Youngstown to New Castle; E. Palestine to Beaver Falls; St. Clairsville to Washington; Sharon to Warren; E. Liverpool to Beaver and Steubenville to Pittsburgh.

S. C., Rock Hill—Bids will be asked in December for 150,000 sq. yds. sheet asph. paving. Gilbert C. White, Engr., Durham, N. C.

S. D., Mitchell—City may add to seven mile paving program. Resolution to pave W. 11th Ave.—Main to Wisconsin street (5 blks.)—Introduced as result of petition from property owners. Petition also filed to pave W. 2nd Ave.—Minnesota to Iowa Sts. This has been referred to the Comm. of Water & Sewers as there are no connections on this street.

S. D., Yankton—Co. Aud., Yankton Co., Petitioned to hold special elec. to vote on $3,750,000 bonds for hard roads; 102 miles paving, 18-ft., 22-ft. wide, from here to James River; also 92 miles gravel road; $500,000 will be state and fed. aid roads.

Tenn., Humboldt—City will ask bids abt. Feb. 1st for constr. of 4 to 5 miles of asph. and asph. conc. streets; $250,000. J. H. Weatherford, Engr., Memphis.

Tenn., So. Nashville—So. Nashville Impvt. Club requests permanent street impvt. as follows: Third Ave., so—Franklin to Lindsay Ave.; First Ave.—Lindsay Ave. to Carroll St.; Lindsley Ave—Third to Hermitage Ave.

Tex., Brownwood—City contemplates paving business section—about 2 miles macadam and binder paving.

Tex., Brenham—$1,500,000 bonds sold by Washington Co., for road constr. Dallas, Tex.—Resolution ordered Harwood St. widened from Ross Ave. to Cedar Springs passed by City Comn. Cost will be abt. $68,000 for paving and impvts.

Tex., Dublin—Following adoption of general paving law by almost unanimous vote of citizens, Council has authorized prelim. survey looking to paving of business section of town.

Tex., Fort Worth—County Commrs. Court has appointed R. V. Glenn, Supervising Engr., for constr. of more than 300 miles of good roads in Tarrant Co. $3,650,000 will be expended by county for rds., brdgs. and culverts. Of this sum $200,000 is Fed. aid., which must be used on 3 main hwys. Total of $116,000 provided for constr. of 5.8 miles conc. rd. on Fort Worth-Dallas Rd.; $60,000 for bldg. hard-surf. 10-mile strip on Camp Hicks Rd. and $24,000 for 6.2 mi. blk. on Benbrook or Weatherford Road. Bids for this work will be opened abt. January 1st, 1920. Mr. Glenn expects to have his estimates and survey records ready for contractors early in December.

Va., Richmond—Hwy. Commr. Coleman announces he will begin calling for bids for road work in January and February and that contracts will be awarded with all possible speed so work can begin with opening of Spring.

Wn., Aberdeen—Aberdeen Chamber of Commerce advocates a $1,200,000 rd. bldg. program in county, in addition to projects already planned which amount to $4,000,000. Comm., at recent meeting, asked $300,000 for the Aberdeen and Hoquiam projects, including intercity road betw. the two cities.

Wn., Everett—City Engr. Dean estimates cost of paving 10th St., and Rucker Ave., at $20,417. Will improve with concrete. St. will be 30-ft. wide.

Wash., Seattle—Rd. bldg. program for 1920 has now been practically laid out by Co. Engr. Sam Humes. Plans being prepared for projects listed by Commr. Smith of the south district and Commr. Dobson of the north district. Commr. Smith desires plans made for following paving projects so that contracts can be let early in 1920: 3 mi.—Enumclaw easterly towards Palmer; 2 mi.—Auburn to the Green River brdg. on rd. to Black Diamond; 1½ mi.—Kent westerly toward Des Moines; 2 mi.—Kent easterly toward Black Diamond; 2 mi.—O'Brien brdg. west to paved road—total abt. 10½ miles and wil cost abt. $300,000; plans will also be prepared for grading Hall Rd.—Redondo Beach to a connect. with the High Line Rd., abt. one mile; Roxbury St. along so. city limits of Seattle, abt. 1 mi. and Pocahontas Rd. near Palmer Jct., 1½ miles. Grading and graveling only and will cost abt. $50,000 to $60,000. Commr. Dobson of Third Dist. requests preparation of plans for Richmond Beach rd. from brk. rd. at Richmond Highlands to connect with present paving in town of Richmond Beach, 2 mi. long; also Redmond-Hollywood Rd., 4 mi. Est. cost abt. $180,000. Commr. Dobson requests plans for a total of approx. 50 miles hwy. constr. and repair at est. cost of about $350,000.

W. Va., Martinsburg—City will let contract in spring for 2 miles paving and sewers; $500,000. E. G. Tankin, Mayor.

Wis., Eau Claire—Although City has not yet laid out its street paving program, there are two good sized items that will be included and these are of such size that they will probably constitute the largest part of the program: Concrete highway from so-called asylum road from city limits where present conc. hwy. ends to Third St.—about 4,000 ft.; concrete pavement on Birch St., from juncture of street with new Eau Claire-Chippewa Falls Hwy. and Putnam St.

Wis., Evansville—City Council will include $5,000 for street machinery in budget of 1920. Ray Gilman, City Clk.

SEWERAGE AND SEWAGE TREATMENT

Cal., Los Angeles—Ord. adopted by Council for constr. of sewers in 62nd St.—Figueroa St. to Moneta Ave.; also for sewers in Norton Ave. betw. Country Club Dr. to 8th St. City Engr. instructed to allow property owners on Serrano Ave. no. of Sunset Blvd., to construct sewers under private contr., using specfs. 112. Petitions filed from owners on New Hampshire Ave.—Santa Monica Blvd. to Lexington Ave—for sewers in this street and have been sent to City Engr. for his recommendation.

Cal., Los Angeles—City will appropriate $3,000 to pay its share of proposed sewers on Terminal Island at the harbor. Est. cost $34,000.

Cal., Los Angeles—City Engr. instructed by Council to prepare Ord. for sewers in St. Andrews Pl.—24th St. to 300 ft. southerly; also to prepare plans for constr. of sewers which will be required in the permament improvement of Washington St.—West Blvd. to Vineyard Ave.

Cal., Los Angeles—City Engineer Hansen recomends the use of individual septic tanks for sewerage on properties located in sects. of city where regular sewer systems have not been installed.

Cal., Pasadena—Proceedings will be instituted to complete proposed no. west storm drain, the lower end of which on Seco. was finished when work was stopped on acct. of the war. It is proposed to complete the project using Glen Ave., a natural water course.

Cal., San Bernardino—Council has approved plans and specfs. for 19,210 ft. sewers to be built in southwest section of City. Sewers will be 6 to 12 in. W. D. Brown, City Engr.

Cal., Taft—City Engr. E. M. Lynch, Central Bldg., Los Angeles, instructed by City Trustees to prepare plans for sewers and fire system in Dist. east of Center St.

Ill, Canton—Chas. H. Dunn, Peoria, appointed engineer to have charge of proposed sewer improvements.

Ill., Carlinville—Additional sewer district for city being planned. It is to take in all territory west of North and So. Broad St., and will drain new addns., Pershing Pl., Stratton Pl., Otwell Addn., Burke Addn., etc.

Ill., Elgin—City has been ordered to install sewage disposal system, in order to abate the pollution of the Fox River. Improvement will cost about $350,000.

Ill., Morton—City contemplates installing sewer system at cost of $80,000.

Ill., Springfield—Bd. Local Impvts. have received petitions for following sewer impvts., for which ests. and plans are being prepared by City Engr., Wade Seeley: 12-in. sewers in Phillips Ave.—15th to 17th, 12th St.—Cornell to alley so. of Ash; Matheny Ave.—17th to 19th. Impvts. will be passed favorably by Bd. and Ords. prepared as soon as ests. are completed.

Ill., Streator—Consulting Engr. Clausen has completed drawings for proposed sewer system. Plans call for elimination of the two crks. that now carry sewage through city For further information address City Engr. Renz.

Ia., Des Moines—Plans and specfs. for sewer system in Waveland Park approved by City Council.

Ia., Sac City—City Council has ordered construction of several storm sewers; also considering bldg. in near future a sewage disp. plant.

Kans., Pittsburg—City Comn. instructed City Engr. L. E. Curfman to prepare estimates of cost of bldg. sewage disp. plant on Cow Creek.

Ky., Louisville—$2,000,000 bonds voted by City for sewer system. David R. Lyman, City Engr.

La., Minden—Town plans $100,000 sewer system. K. A. Kramer, Consit. Engr., Magnolia, Miss.

Ia., Monroe—$490,000 bonds voted to construct draing. system; enlarge and improve house sewer system. W. G. Kirkpatrick, Consit. Engr.

La., Monroe—City voted $12,000 bonds to construct disp. plant and incinerator. Arnold Bernstein, Mayor. Walter G. Kirkpatrick, Consit. Engr.

La., Shreveport—$400,000 bonds voted to extend sewer system and improve water works.

Md., Baltimore—City will extend sanitary sewers in annex; $250,000. Geo. F. Wieghardt, Hwys. Engr.

Mass., Boston—Commissioner of Public Works states it is his intention to construct surf. drain for 15-in., 12-in., and 10-in. earthen pipe, 4 catch basins and connections; also 315 ft. 6-in. surface drain connect in Wilcock St., betw. Morton St. and Blue Hill Ave. in the Dorchester Dist. Est. cost $4,000; also surf. drain 20-in. and 12-in. earthen pipe and one catch basin and connection in Brown Ave.—Blakemore St. and abt. 65 ft. southwesterly of Garden St., W. Roxbury Dist. Est. cost $2,676; also about 30 catch basins and about 400 ft. 6-in. earthen pipe catch basin connections in various streets in city proper, $8,907.

Mass., Boston—Commr. of Public Works states it is his intention to construct surf. connections with surf. drain in Havelock St.—Morton St. to Blue Hill Ave.—Dorchester Dist. Est. cost $4,000; sanitary sewer 10-in. earthen pipe in Oak Ave. at est. cost of $400 and sanitary sewer 10-in. earthen pipe in Colorado and Almont Sts., at est. cost of $1,000.

Minn., Duluth—Petition being circulated for construction of sewers sys. in Smithville Div. of Duluth. J. A. Farrell, Commr.

Minn., Duluth—City Commrs. have ordered sewers constructed in Woodland Ave. —Niagara St. to Norton Sts. Est. $5,027; also sanitary sewer in 57th alley W. from Highland Street to blk. 25, 6th Div. Est. $450. J. A. Farrell, Commr.

Minn., Duluth—City Commrs. authorized sanitary sewer in Lexington St., 63rd Ave. west to 64th Ave., W., with outlet in 64th Ave., W. to Worden alley. Est. cost $6,442. Will soon ask bids. J. A. Farrell, Commr.

Minn., Hutchinson—Jno. W. Schaffer & Co., Consit. Engrs., 501 New York Life Bldg., Minneapolis, making plans for storm sewer; 40 blocks. F. N. Moore, City Clk. $100,000.

Minn., St. Cloud—City considering construction of sewers on 13th Ave., 7th St. to 10th St. A. W. Buckman, City Clk.

Minn., Wells—City will probably take bids in January for storm and sanitary sewers; extend present sewers. Consit. Engr. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, G. G. Busche, Vil. Recorder.

Miss., Jackson—$30,000 bonds authorized by voters for sewer system extension.

Mo., Mexico—$25,000 bonds voted by City for constr. of sewage disp. plant. J. F. Harrison, Mayor.

Neb., Papillion—Village contemplates sewer sys. in Dists. 1, 2 and 3. Geo. Oliver, Clk.

Neb., Wymore—City will sell two parks for sewer system fund. Est. at $60,000.

N. J., Elizabeth—Health Officer Louis J. Richards is preparing list of streets without sewers and will request Board of Works to order sewer extension in all such cases.

N. J., Paterson—Business men on main thoroughfares ask enlargement of sewer system. Arthur V. Livingston, City Clk.

N. M., Albuquerque—City Commrs. have instructed City Mgr. to go ahead with constr. of storm sewer in Iron Ave.

N. Y., Croton-on-Hudson—Village has rereived offer from Baroness de Grafenried of $2,000 plot of land, providing officials pledge themselves to begin work of constructing sewage disp. plant in 60 days from the making of the offer. Offer reasonably sure of acceptance.

N. Y., Salamanca—New system planned for southwestern section of city at est. cost of $20,000.

N. C., Avondale—Cliffside Mills, Cliffside, N. C., considering installing 500 septic tank sewage-disposal outfits in operatives' House. Sanitary Engrg. Co., Engrs., Charlotte, N. C.

N. C., Mount Airy—$75,000 bonds voted for sewer system.

N. C., Lumberton—Jennings Cotton Mills —H. B. Jennings, Pres.-Treas.—install sewer pumping station for 10 operatives' houses. Tucker and Laxton, Archts, Charlotte, N. C.

O., Akron—City considering constr. of a 6,000-ft. tunnel for West Side sewage into the Big Cuyahoga river. Wm. H. Ditton, Engr. for State Health Dept.

O., Cleveland—Co. Commr. Jos. Menning will offer resolution authorizing creation of proposed new draing. dist. through western half of county, as petitioned for by residents of Middleburg, Royalton, Parma and Brooklyn Heights Twps. Sewer lines and 3 disposal plants, to cost approx. $3,000,000, are embraced in the project.

O., Lorain—Resolution adopted to construct sanitary sewer in Cornell Place.

O., Painesville—Ordinance passed to construct sanitary sewer in Bank St.

O., Ravenna—Council petitioned to constr. sanitary sewer on W. Spruce from Madison to city limits; also sanitary sewer on E. Main—Liberty to City Limits, about 325 ft. Ord. passed to issue bonds in sum of $14,000 to pay expense of constructing sewers on sects. of S. Freedom, Liberty, E. Main and E. Spruce Sts., W. Spruce St., Hill alley, Harris Ave., Sycamore St., Central Ave .and Clinton St.

O., Sandusky—Sewer on Jackson St.—Market to Water—is to be lowered at cost of $2,120. City Engr. Johnson.

O., Toledo—Resolutions adopted to construct sanitary sewers in Main Sewer Dist. No. 23—cylindrical D., vitr. pipe 8 ins. inside diam.; together with manholes, flush holes, house branches, appurts., etc.; similar sewer constr. in Dist. No. 2; also local combined sewer No. 1378 in Dist. No. 39½ cylindrical vitr. pipe 30-in., 24, 22, 20, 18, 15, 12 and 8-in. diam., together with neces-

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sary appurts. C. C. Kilbury, Pres. of Council; A. W. Payne, Clk.

O., Toledo—Residents of Perrysburg and Rossford and adjacent vicinity plan to construct trunk sewer to meet all needs for next forty years and to connect with proposed interesecting sewer to be built in Toledo. W. H. Dittoe, Chf. Engr. of State Bd. of Health, at joint meetings outlined plan to bring the project to a finish.

Ore., Bend—City Council has approved plans for extension of sewer system. Est. cost $133,000.

Ore., Portland—In addn. to large impvt. program, for which plans are completed, Commr. Barbur has announced plans for another group of impvts. are ready. Included in previous report is $125,012 for sewers. List just issued calls for expendt. of $136,037 for sewer construction.

Okla., Hominy—City considering construction of sewer improvements. C. E. Lee, Engr.

Okla., Sallisaw—City will extend and improve sewer, water and electric light systems. $140,000 bonds voted.

Pa., Beaver Falls—Plans for sewer have been drawn and will be sent to State Bd. of Health for approval. Plan calls for use of settling tank on river bank and drop into river 250 ft. from shore.

Pa., Du Bois—Ord. passed to construct sewer on Wayne St. and Water alley; also in East St.—Pleasant St. to Fifth St.

Pa., Harrisburg—Ord. passed by Council appropriating $12,000 for repair of Mish Run Sewer and for the closing of York St.

Pa., Scranton—Mayor A. T. Connell has requested Council to appropriate $5,153 for making repairs to sewers in the 100 blk. of South Bromley Ave., West Scranton.

S. C., Arcadia—Arcadia Mills may install sewer and water systems; 2 miles trenching; 160 houses. J. E. Sirrine, Archt.-Engr., Greenville, S. C.

S. C., Orangeburg—$850,000 bond issue carried here for sewer and water extensions, street paving, sidewalks and gas plant; also erect. of an electric white way.

S. D., Kimball—$25,000 bonds voted for constr. of sewerage system and installing disposal plant and outlet.

Tenn., Nashville—Commr. Lewis has introduced bill to appropriate $5,000 for sewer in Jackson and Warren Sts., and in 3 alleys connecting with sewers in Jackson and Warren Sts., and 10th and 11th Aves.

Tex., Alphine—$35,000 bonds voted by citizens for constructing sewer system.

Tex., Dallas—City will construct sanitary sewer for Oak Park addn., provided property owners pay $20 per house. Money being collected and it is expected work can be let and completed by end of year.

Tex., El Paso—City considering constr. of sewage disposal plant. $100,000 bonds voted. Chas. Davis, Mayor.

Tex., Lufkin—City contemplates $13,500 sewer impvts. and extensions.

Va., Roanoke—$250,000 bonds voted by City to construct sewer and drainage systems. A Ward Morris, City Engr.

Wis., Cedarburg—Preliminary survey for sewerage and water works will be completed within week or two Data will then be compiled by the engineers and est. of cost prepared.

Wis., Cumberland—City will probably take bids in January for 10 blks. paving and sanitary sewers. Consit. Engr. L. P. Wolff, 100 Guardian Life Bldg., St. Paul. A. W. Norton, City Clk.

Wis., Marshfield—City Council contemplate sewer construction. Engr. not selected. Will probably ask bids in Spring. Jno. Shubert, City Clk.

Wis., Milwaukee—City Bd. of Ests. informed by T. C. Hatton, Chief Engr., and Harrison P. Eddy of Boston that it is imperative to the city's future welfare to proceed as rapidly as possible with erection of sewage disposal plant on Jones Island.

WATER SUPPLY AND PURIFICATION

Ariz., Phoenix—Plans and specfs. being being prepared by Hiram Phillips. Consulting Engr., 801 International Life Bldg., St. Louis, for an infiltration system for Phoenix. Project will cost about one million and a half dollars and will consist of 32 miles of [illegible]-in. pipe to bring the water from mountains to city. Bids will probably be asked on wood, conc., cast iron pipe, etc. Concrete covered reservoir 400 ft. square and [illegible] ft. high will be built; also numerous other structs. such as sand strainer house, stand pipe, etc.

Ark., Springdale—City Council has notified a St. Louis Engineer that his services are required immediately for the constr. of a water plant. Est. cost $94,000. Legal formalities have been approved and system is expected to be completed within the next 12 months.

Cal., Brawley—$125,000 bonds voted at recent election to provide for impvts. and extensions to city's water system. Larger mains wil be laid, additional fire hydrants placed and new tank tower constructed. Geo. B. Wade, City Engr.

Cal., Brea—Olmsted, Gillelen, Hollingsworth Bldg., are preparing plans and estimates for improving present water system which will be purchased by City. Bond elec. to be called within 30 to 60 days.

Cal., Glendale—$260,000 bonds voted. Funds to be expended as follows for water and light departments: New pumping plant with 2 wells and pump for each and large booster pump at San Fernando Rd. and Grand View Ave., cost $33,500; new 30-in. trunk line from Doran St. to entrance to Verdugo canyon, $35,000; 7,500,000-gal. reservoir at entrance to canyon, $40,000, new 20-in. pressure main from reservoir to abt. middle of Verdugo canyon, $34,300; row of wells across middle of Verdugo canyon to bed rock, with pumps to raise water to a small reservoir or settling basin, $32,000 16-in. pressure main from main pumping plant to Grand View Ave., $19,000; reservoir at Grand View Ave., $8,000; pumping plant at Grand View reservoir, $3,000; 5 mile new water mains and laterals, $34,250; elec. generating plant at canyon reservoir with 100 kilowatt generator driven by Pelton wheel, $9,700 purch. of additional gravity water shares, $10,000.

Cal., Monrovia—Election will be held in Janaury to vote on issuing $90,000 bonds for development of city's water supply.

Cal., Ontario—Election soon to vote on issuance of $56,000 bonds to purchase water bearing land near foothills and impvts. at E. 4th St. water development.

Cal., Orland—City Engr. instructed by Council to make survey of proposed extensions of water and sewer systems.

Cal., Pasadena—Geo. S. Patton, San Marino, will abandon present reservoir and well for the Oak Knoll water system and sink new well and construct new reservoir on other property.

Cal., San Diego—Council has instructed Mgr. of Operations, W. H. Judy, to make survey of proposed pipe line to connect with water system with the San Dieguito water system. With this survey he is to include an estimate of cost. The pipe line, if constructed, will run betw. La Jolla, at the terminus of present city system, to city boundary line near Del Mar.

Cal., Tracy—City will lay 3,200 ft. of 4-in. water main.

Cal., Yucaipa—Redlands and Yucaipa Land Company has decided to complete water system for that sect. of valley known as the Dunlap ranch. Several pumping plants will be established, reservoirs constructed and steel pipe lines laid. $100,000 approx. cost. G. A. Atwood, Gen. Mgr.

Conn., Bristol—Board of Water Works Commrs. propose constr. of new reservoir to be known as reservoir No. 5, located on each branch of Poland Brook.

Colo., Williambsburg—Bonds voted by town for purpose of constructing water works system.

Ga., East Lake—City may construct $15,000 water works; artesian well 100,000 to 200,000-gal. capy. tank.

Ga., Macon—Water main extension will be constructed from terminus of main to the Rivoli Dist. $20,000 raised by citizens of suburb for the impvt. J. D. Kinnett, Chrmn. of Water Bd. Comn.

Ill., Burr Oak—Village has sold $15,500 bonds. Funds to be used for constr. of water supply station, work on which will go forward soon.

Ill., Westville—Mr. G. F. Habemeyer, Engr., from State Water Survey of University of Ill., recommends that water from the Kelly No. 4 air shaft can be used by City if satisfactory arrangements can be made for furnishing 150,000 gals. per day.

Ia., Decatur—City expects to spend one million dollars for purification and improvement of water supply. State Dept. of Health has approved the plans and work will begin at once.

Ia., Sac City—Voters of Auburn have petitioned Council to call election to vote on $20,000 bonds for purpose of establishing water works.

Ia., Toledo—Evinger Engineering Co., 222 Davidson Bldg., Des Moines, Consit. Engrs., are making tests for new water supply here. E. A. Benson, Clerk.

Ia., Woodward—Present deep well system inadequate. Evinger Engrg. Co., Des Moines, Consit. Engrs. making test for new water supply. Owner, State Bd. of Control, Mr. Treat, Secy.

Ky., Harrodsburg—Water conditions so alarming that measures must be taken immediately to construct dam and filter plant. Address Chairman of Bd. of City Commrs.

Ky., Maysville—Maysville Water Co., contemplates constr. of filtration plant; $60,000; also pumps.

Ky., Versailles—City contemplates constructing plant on Kentucky River, $75,000; daily capy. 500,000 gals. U. C. McCauley, Chrmn. W. W. Comn. Edgar B. Kay, Engr., 1416 R St., N. W. Washington, D. C.

La., Monroe—$450,000 bonds voted by City to construct water works and electric light and power plant. Walter G. Kirkpatrick, Consit. Engr.

Md., Baltimore—Immediate expendt. of $8,331,000 to increase the water supply of city is urged in report submitted by expert to Mayor and Board of Estimates. Work recommended for immediate construction is as follows: Dam 120 ft. high with crest election 520 ft. on Upper Gunpowder Falls below Prettyboy Branch, impounding 23,000,000,000 gals. of water, all available by simply opening the outlet gates and allowing the water to flow down river to Loch Raven. Cost est. at $2,031,000; construction of an additional mechanical filtr. plant of 128,000,000 gals. per day capy. on west side of Hillen Rd., at total cost $2,700,000; constr. of an additional 12-ft. tunnel 7.5 miles long through solid rock from Loch Raven to Montebello Filters, to reduce friction losses betw. these points at total cost of $3,600,000. Various other impvts. urged for constr. at later date.

Mich., Detroit—Plans of Essex Border Utilities to consolidate the water systems of Windsor and Walkerville to supply the seven border municipalities with filtered water at cost, will be submitted to ratepayers at elections in January.

Mich., Flint—At the rate petitions for water mains are being received at office of water Board in City Hall, Mr. Baldwin, Supt., believes that 30 to 40 miles of mains will be laid in 1920.

Mich., Lansing—Alvord & Burdick, Hydraulic and Sanitary Engrs., Chicago, are making survey for proposed impvts. to water works system.

Minn., Bemidji—City Engineer authorized to build pump house over deep well pumps. Geo. Stein, City Clk.

Minn., Forest Lake—Plans under way for water works construction. Engr. Druar & Smith, Globe Bldg., St. Paul. P. A. Anderson, Vil. Recorder.

Mo., Boonville—City considering water works extension, installing mains, etc., $45,000.

Mo., Breckenridge—City considering bldg. water works.

Neb., Auburn—Will soon hold election to vote on $55,000 water works bonds. Archer & Stevens, 609 New England Bldg., Kans. City, Mo., Engrs. Impvts. include new boilers, pumps, enlarging of plant and pipe extens. R. M. Armstrong, City Clk.

Neb., Lincoln—$200,000 water works impvt. bonds carried at recent election. Burns & McDonnell, 402 Interstate Bldg., Kansas City, Mo., Consulting Engrs. Theo. H. Berg, City Clk.

Neb., Lincoln—City Engr. Bates completing plans for constr. of cutoff walls in two reservoirs at A Street pumping station. Est. $5,000. Comr. Schroeder will probably not call bond issue elect. as authorized until Spring. Theo. H. Berg, City Clk.

N. J., Morrisville—$45,000 bonds carried here for furnishing pure water supply; artesian wells or filtration plant.

N. J., Trenton—New Jersey Public Utilities Comn. has ordered the Hanover Water Company to improve its plant.

N. C., Asheville—City considering extending water works; 10 miles gravity pipe line, 16-in. diam.; to intake Bee Tree Crk., $350,000. J. R. Sherrill, Commr. Public Works.

N. C., Lumberton—Jennings Cotton Mills—H. B. Jennings, Pres.-Treas.—will install water works for 100 operatives' houses.

Send in Your News Items

Municipal and County engineers and other public officials having to do with construction work, as well as consulting engineers, are requested to send us for publication in this department items of news relating to: Bids Asked, Contracts Awarded, and Prospective Work.

It is our function to make such news public, and to collect it also, so far as we are able, but we cannot collect all the news unaided except at absolutely prohibitive cost. Will you not cooperate by sending in the essential news pertaining to your work? We will disseminate it free of charge.

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Tucker & Laxton, Archts.-Engrs., Charlotte, N. C.

N. D., Lidgerwood—Plans being drawn for reservoir and tank. W. C. Buck, Engr., 1245 W. Minnehaha Ave., Minneapolis.

O., Ashtabula—Construction of huge reservoir being considered, largely for the development of the steel industry in Youngstown and Pittsburgh district, which are greatly in need of a more adequate water supply.

O., Berea—Resolutions adopted to construct water pipe line entire length of Forest Avenue; city also considering issuing $80,000 bonds for purpose of improving water works and electric light plant.

O., Canton—Resolution adopted by Council recommending that water mains be laid on Root, Superior and Taft Ave., N. E., in the near future.

O., Cleveland—Resolution adopted by Council to construct water main; together with all appurts., in Flowerdale Ave., S. W. —Pearl Rd., S. W. to Ridge Rd., S. W. Harry C. Gahn, Pres. of Council.

O., Defiance—Service Director Myers authorized by Council to enter into contract for constr. of $180,000 water filtration and purification plant. He will advertise for bids in near future.

O., Newark—Chamber of Commerce in favor of enlarging water system; also installing sewer system.

O., Ravenna—Ord. passed to issue bonds to increase water supply by completing water conduit line now under construction, bldg. diversion centrif. pump at Muzzy Lake and providing for emergency electrical connections.

O., Chardon—$20,000 bonds approved by citizens. Funds will be used for water works system.

O., Wauseon—Plans being made to construct reservoir here near city water works plant. Est. cost $142,000.

Okla., Clinton—$350,000 bonds voted to extend water works.

Okla., Depew—City has voted $45,000 bonds to extend water and light systems.

Okla., Sallisaw—Citizens voted $140,000 bonds for extending and improving water, electric light and sewer systems.

Okla., Waukomis—City contemplates rebldg. water works pipe lines; $18,000.

Okla., Wilson—City may construct $80,000 water works addns.; well and steam power; water and electrical distribution systems; two 200-h.p. boilers; 200-h.p. engine with generators. J. W. Ryder, Engr., 614 C St., N. W., Ardmore, Okla.

Ore., Monmouth—$60,000 bonds voted at recent election for constr. of gravity water system. Project is to take water from Teal creek, 10 mi. away. Active work will start in near future with view to having project completed by next Summer.

R. I., Woonsocket—Council being strongly urged to take immediate steps for improving the water supply sys. by bldg. new tanks and laying larger mains.

S. C., Arcadia—Arcadia Mills may install water and sewer systems; 2 miles trenching: 160 houses. J. E. Sirrine, Archt.-Engr., Greenville, S. C.

S. C., Orangeburg—City will extend water works. $45,000 bonds voted. W. A. Livingston, Mayor.

S. C., Rock Hill—$100,000 bonds voted for water works extension. Gilbert C. White, Engr., Durham, N. C.

S. D., Humboldt—$15,000 bonds voted for extension of water mains.

S. D., Sioux Falls—City will hold spcl. elec. to vote on $375,000 bond issue for water system. Walter C. Leyse, City Clk.

Tex., El Paso—City will install $200,000 water mains and reservoir; 150,000-gal. Redwood tank to supply high levels.

Utah., St. George—Engrg. work for the constr. of the proposed water system here will be commenced by Caldwell and Richards, Hydraulic Engrs., Salt Lake City, within a few days. It is planned to pipe water to the town from a canyon in the Pine Valley mountains—about 16 miles over a rocky plateau. The engineers are also planning to make survey of town site at same time, in view of possibility of starting draing. work by town next Spring. Project will necessitate large expendt. of money as it wil be necessary to tile drain entire town site.

Wash., Anacortes—Resolution introduced in Council providing for installing 10-in. water main along certain city streets. Est. cost of impvt. $12,000. City Engr. preparing plans.

Wash., Bellingham—Municipal Water Bd. will construct 8-in. c. i. water main along Illinois street and Northwest Diagonal Rd. to city limits. Approx. cost $14,500

Wash., Marysville—Construction of a reservoir is conceded by engineers to be the most feasible plan for Marysville's municipal water supply. Abt. 5 miles of pipe line in town proper would be necessary, it is estimated, to provide sufficient service for all needs. The proposition hinges on matter of plant income which will be estimated by careful survey of entire community and well-settled farm country through which the main feed line wil pass. To reach the Sultan river pipe line City will have to build a feed line approx. 9 miles long.

Wash., Walla Walla—Special elec. to validate proposal to issue $500,000 in bonds to extend and improve city water system has been called by City Commrs. Proposition to be voted on includes entire program submitted by Engr. E. B. Hussey of Seattle and includes bldg. of a 24,000,000-gal. reservoir, extension of present intake to point half a mile above Tiger canyon, which is in the forest reserve, an da new

30-in. pipe line extending from proposed reservoir to city limits.

Wash., Wenatchee—Water Commr. White and Water Comn. of Council have completed plans for bldg. 2 large pipe lines and $50,000 worth of bonds will be sold to pay for the construction of th elines. Main line will be 14-in. main from city's intake on the Squilchuck to the Onanogan Ave. reservoir. From the reservoir a larger pipe will be laid to serve the western portion of city in place of existing main.

Wis., Cedarburg—Prelim. survey for water works and sewerage system will be completed within a week or two. Data will then be compiled by the engineers and est. of cost prepared.

Wis., Eau Claire—Preliminary work on city's $125,000 water works impvts. will begin in about a month. New weel will be sunk next Spring which wil also add to capy. of plant. Water main extensions on a rather large scale wil be made during Spring and Summer. City Engr. Garnock is also Water Wks. Supt.

Wis., Rhinelander—Three experimental wells will be drilled here and vicinity under direction of expert engineers recently employed by City for purpose of making recommendations on proposed water system. Purity of present supply will be taken care of by the installation of a chlorine plant, purch. of which was authorized by Council at prive of approx. $1,100.

Wis., Rio—Will take bids this Winter for water works system; work to begin in Spring. $28,500 bonds voted. W. G. Kirkchoffer, Engr., Madison.

BRIDGES AND BUILDINGS

Ala., Decatur—Business men of Tenn. Valley very optimistic over outlook for constr. of bridge across Tenn. River at Decatur. Bridge will be erected at point to be designated by government engineers. It will be on "Bee Line" route of Jackson Hwy., the North and South Hwy. and Muscle Shoals Hwy.

Ark., Little Rock—Contracts will probably be awarded by January, 1920, for constr. of 2 rein. conc. bridges over Ark. River; one at Broadway and one to supersede the old steel structure at Main St. Pat F. Ring, County Clk.

Ark., Fayetteville—Appropriations authorized for constr. of steel bridges at Ill. Chapel on Illinois River, Rickett's Ford on Muddy Fork and across White River at Elkins, etc.

Cal., Los Angeles—Specfs. for Anaheim Street brdg. over Pacific Elec. tracks near Gaffey St., Wilmington, will be sent to City Council by Bd. of Pub. Wks. with request for authorization to advertise for bids and award. the contr. Bridge provided for in plans for public impvts. on which Impvt. Dist. at Wilmington authorized bond issue.

Cal., Porterville—F. W. Pease, City Engr. instructed to prepare plans and specfs.; also est. cost of bldg. new Main street brdg. over Porter slough. It has been roughly estimated that new brdg. and removal of old struct. wil cost City abt. $30,000.

Cal., San Jose—All the .city-county bridgesover Coyote Crk. must be rebuilt this Winter or closed, according to statement made by Supvr. A. I. Hubbard.

Fla., Arcadia—De Soto County Commrs. contemplate constr. of Charlotte Harbor bridge; $35,000 bonds.

Ga., Savannah—It is planned to construct bridges as follows: Wilmington River, Turners Creek, Tybee River and Lazaretto Crk. Col. F. W. Alstatter, U. S. Engr., in charge of Savannah Dist.

Ill., Belleville—New concrete bridge will be construed in Spring on N. Illinois Street, as result of report received by City Council from special brdg. committee.

Ia., Manchester—Delaware Co. having plans prepare fro bldg. 168-ft, rein. conc. brdg., 45 ft. wide, to have two 80-ft. span arches, 33-ft. rdway, two 6-ft. walks and 4 retaining walls, varying from 25 to 45 ft. long. Abt. $40,000. H. Klaus, Co. Engr.

Me., Augusta—Bridge is to be construted betw. Madawaska, Maine and Edmunston, New Brunswick, as soon as site is chosen by member of the State Hwy. Comm. F. J. Chapleau, Dist. Engr. Dept. of Public Wks., of Dominion of Canada, Montreal.

Mich., Holland—If plans of Ottawa Road Cotmmrs. are realized a new brdg. will span the Black River betw. the city and twp. in near future. Plans and blue prints being made. Survey calls for 24-ft. bridge with foot walks on each side of drive and heavy enough for future traffic.

Minn., Madison—Survey complete for 30-ft. r. c. deck girder span, r. c. abutments, Providence. H. O. Thorson, Co. Aud., Lac Qui Parle Co.

Mo., Jefferson City—State Highway Board has approved appropriation of $10,000 for Lewis Bridge in Canton Spcl. Rd. Dist. on Monticello-Canton Rd.

Neb., Omaha—City will aid Yankton in constr. of river bridge. $1,500,000 project endorsed at meeting of business men. Business men of Yankton, S. D., have raised $400,000; an additional $400,000 was raised in neighboring territory. Amount to be raised in Omaha, $300,000.

Neb., Pawnee City—Pawnee County will build 8 steel bridges and 5 slab conc. bridges. Est. cost $29,000. Geo. E. Johnson, State Engr. Contr. will be let for the fed. aid hwy. this month.

N. J., Atlantic City—Three new bridges will be constructed in Albany Ave. at cost of $500,000.

N. J., Perth Amboy—New brdg. will be constructed to connect Perth Amboy with So. Amboy. Approx. cost betw. $1,500,000 and $2,000,000, including cost of two approaches. W. G. Thompson, State Hwy. Engr.

N. D., Bismarck—Final approval made for 38 ft above hibh water for $1,000,000 bridge over Missouri river from Bismarck to Morton Co. Work will begin in Spring. T. Flaherty, Co. Aud.

O., Cincinnati—Co. Surveyor E. A. Gast has notified Commrs. that the county bridge over Great Miami in Whitewater Twp. will need to be replaced. Est. cost $120,000. He also reported that suspension brdg. over Whitewater river is unsafe for vehicles of more than 4 tons' weight.

O., Columbus—Franklin County voted $375,000 bonds to construct bridge over Scioto River on Greenlawn Ave. C. C. Lattimer, Co. Surv.

O., Youngstown—Citizens voted $175,000 bonds for construction of high level bridge at Lanterman's Falls.

Okla., Cherokee—Plans for constructing 15 new bridges in Alfalfa Co. approved. Est. cost $32,000.

Pa., Bethlehem—State Public Service Commission has authorized constr. of a $6,000-ft. structure at Bethlehem, to cost $2,315,000. Lehigh Valley Reading Railways will expend $1,000,000 in constructing new union station and making track changes in connection with bldg. said brdg.

Pa., Reading—Work will start soon on erection of new city and county bridge over Schuylkill River and canal in Reading at cost of $653,000.

Pa., Philadelphia—It is planned to construct a Delaware River brdg. at cost of $250,000. Jos. P. Gaffney, Chrmn. Finance Comm.

Pa., Philadelphia—County Engineer requested to draw plans for rebldg. of a number of county bridges. Contracts will probably be let during Winter for Spring work. Among the new brdgs. planned are: Manada Crk. brdg. at Sand Beach, one in Bear Creek, in Wiconisco Twp., one crossing Phila. & Read'g. Ry. tracks at Boyd Station, two betw. Dauphin and Lancaster Cos.; one at Beverly, one at Bellaire, intercounty brdg. on State Hwy. crossing Conewago Crk., and two over Deep Crk., Lykens, Twp.

S. C., Converse—State Hwy. Comn., Columbia contemplates bldg. 400 ft. concrete bridge over Pocolet River; $45,000.

S. D., Sioux City—Will probably take bids on 24 bridges in Jan. or Feb. Co. Engr. C. A. Wagner, Courthouse, now making plans. Includes some 2 span bridges; may be some steel spans. E. H. Shenble, Aud.

Utah, Salt Lake City—Salt Lake County is planning to construct a bridge as War Memorial, across Parley's canyon to be part of the Wasatch Bonneville Blvd. Rein. conc. is favored for the bridge.

Wash., Seattle—Following bridges to be built in 1920. Plans called for bridges in second district: Riverton brdg. over Duwamish River at Allentown; Orilla brdg. and O'Brien brdg., both over White River at Orilla and O'Brien, respectively; Lee Hill brdg. over White River at Auburn: all foregoing will be of steel with conc. piers. The brdgs. for which plans are asked by Mr. Dobson of 3rd Dist., include 3 bridges over Cedar River, located on Renton-Maple Valley Hwy. The Issaquah brdg. which will be a conc. arch, on Sunset Hwy., Fall City brdg. over Raging River at Fall City and Novelty brdg. over Snoqualmie River at town of Novelty. All the foregoing, with exception of the Issaquah, will be constructed of steel with concrete piers. Entire cost roughly estimated at $250,000. Plans being rushed to completion in order to call for bids at earliest possible date.

Wis., Grand Rapids—Bonds voted for constr. of large conc. bridge over Wisconsin River here. Est. cost $210,000. Most ornamental bridge on Wisc. River is planned.

Wis., Madison—State, Counties of Columbia and Sauk, town of West Point and village of Prairie du Sac are combining to build new free brdg. over Wisconsin River at last named place. Est. cost $150,000.

Wis., Racine—City contemplates erection of following: State Street bridge (bascule) $250,000; Sixth St. brdg. and viaduct, $150,000 and Milmine brdg. conc. arch, $50,000. P. H. Connolly, City Engr.

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Construction News and Equipment Section

Beginning with the January, 1920, issue the present contract news section of Municipal and County Engineering will be improved by widening its appeal. In addition to the construction news items articles on equipment will be published.

The articles on equipment will consist of short descriptions of new and improved equipment, of course, but of much greater interest is the fact that longer articles will be published on the selection, operation and maintenance of equipment used in the several branches of municipal and county work. These are the matters of greatest interest to the contractor and to the construction engineer.

Cooperation in the production of this section is invited from **the editorial standpoint.** Send us illustrations and descriptions of new and improved labor-saving equipment and articles on the selection, maintenance and operation of equipment.

What considerations affect the selection of equipment in your line? What suggestions do you have to offer on the maintenance of equipment? How should equipment be handled to produce the best results?

Your cooperation in answering these questions is requested.

Special circulation will be given the Construction News and Equipment Section as a separate periodical containing information of undoubted interest to all contractors.

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